Towards a Transnational Law of Climate Change: Transnational Litigation at the Boundaries of Science and Law

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ABSTRACT

My PhD project engages in a micro-level examination of the institutional character and knowledge work of the Intergovernmental Panel on Climate Change (IPCC), maps the judicialisation of climate change in terms of the evaluation and certification of climate science by domestic courts, and considers the role of climate litigants (e.g. environmental NGOs and future generations) in terms of the cross-fertilisation of science-driven argumentation and advocacy strategies across numerous jurisdictions. More specifically, by undertaking a detailed examination and analysis of salient climate change lawsuits which embody substantive discussions about climate science, my PhD thesis argues that through the production, certification and use of climate science in litigation, the IPCC, domestic courts and litigants are co-producing a new and emergent body of transnational law and jurisprudence on climate change. Since this is largely judge-made law, I posit that it can be thought of as a kind of co-produced *'transnational climate change case law.'* I apply a Science and Technology Studies (STS) lens to frame my analysis of climate science as a form of *applied science* and *trans-science* and argue that the work of the IPCC, courts and litigants in relation to climate change can be regarded as a complex network of interactive relationships and hybridised knowledge practices, including: i) *science-policy co-production*; ii) *science-policy-law co-production*; and iii) *science-law co-production*, respectively. This new body of transnational climate change case law is the byproduct of epistemic interactions between these three principal actors, which are circumventing traditional executive and legislative processes. This dynamic signifies a shift away from a purely statist conception of climate change regulation which is largely consistent with the transnationalisation of environmental regulation and law writ large in recent years.

Keywords: climate litigation; STS; climate science; IPCC; courts, ENGOs; co-production; transnational climate change case law

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CHAPTER ONE

Introduction

I. Project Context

In a pioneering speech before a US Senate Committee on 23 June 1988, and amid searing record-breaking temperatures, James Hansen of NASA's Goddard Institute kick-started a global conversation on climate change, which gained traction and paved the way for international recognition of the problem at the 1992 UN Conference on Environment and Development in Rio. Sounding a clarion call for climate action, Hansen urged that the evidence on anthropogenic global warming was now overwhelming and warned of the likelihood of a 2.5°C temperature rise by the end of the 21st century.[1] A leader in the climate science community, Hansen also stands out for his personal activism on climate change. He is a staunch proponent of placing a high price on carbon and pursuing 'a wave of lawsuits' against governments and corporations for causing planetary destruction and violating the rights of future generations.[2] He has also appeared as a plaintiff and expert witness in several climate change lawsuits.

To such scientific advocacy can be added the growing civil society momentum around climate action in recent years and the vocalisation of the intergenerational imperative to address the problem by emergent youth and 'future generation' climate movements, as exemplified by youth climate protests around the world in March 2019. In April 2019,

[1] Phil Shabecoff, 'Global Warming Has Begun, Expert Tells Senate' *New York Times* (New York, 24 June 1988) <https://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html> accessed 10 May 2019.

[2] Jonathan Watts, 'We should be on the offensive' – James Hansen calls for wave of climate lawsuits' *The Guardian* (17 November 2017) <https//www.theguardian.com/environment/2017/nov/17/we-should-be-on-the-offensive-james-hansen-calls-for-wave-of-climate-lawsuits> accessed on 10 May 2019.

protests in London by the organisation Extinction Rebellion – the largest act of civil disobedience in modern British history[3] – culminated in a UK parliamentary declaration of a 'climate emergency.' In the United States, the recently tabled Congressional climate change bill, the Green New Deal, continues to poll favourably with 43% of the public.[4] Indeed, climate change has attained a level of mainstream prominence and a purchase on the public imagination such that it is likely to influence the outcome of future election cycles in many countries. These developments have prompted Bill McKibben and others to declare that we are in "a climate moment" around the globe.[5] Such epistemic-political interventions from the scientific community and civil society actors have become part-and-parcel of the transnational regulatory landscape on climate change and, as will be shown, have considerable power to shape and influence legal and policy responses to the issue. Litigation forms an important prong of global civil society's climate action matrix. The projected exponential growth of climate change lawsuits globally over the next few decades also accounts for a high level of scholarly interest in the topic.

Climate litigation has been recognised as, at least in part, a response to the glacial pace of climate change regulation at the international level and its identification as a polycentric problem that needs to be addressed at multiple levels of governance.[6] Over

[3] Charlie J. Gardner & Claire F.R. Wordley, 'Scientists must act on our own warnings to humanity' (2019) 3 *Nature Ecology & Evolution* 1, 1271.
[4] National Green Advocacy Project Polling, 'Green New Deal' (5-6 March 2019) <https://docs.google.com/presentation/d/1EZVcFhUBfZU6i6VoGJYwH9BRJ6bSSjCL2v6B8-pR8Sw/edit#slide=id.g568bd88eea_0_0> accessed 14 May 2019.
[5] Bill McKibben, 'We've run out of elections to waste – this is the last chance to make a difference on climate change,' *The Guardian* (14 May 2019) <https://www.theguardian.com/commentisfree/2019/may/14/weve-run-out-of-elections-to-waste-this-is-the-last-chance-to-make-a-difference-on-climate-change > accessed 14 May 2019.
[6] William C.G. Burns & Hari M. Osofsky (eds), *Adjudicating Climate Change: State, National, and International Approaches* (CUP 2005) 20; Jacqueline Peel & Hari M. Osofsky, "Climate Change Litigation's Regulatory Pathways: A Comparative Analysis of the United States and Australia," (2013) 35 *Law & Policy* 3; Elizabeth Fisher & Eloise Scotford, "Climate Change Adjudication: The Need to Foster Legal Capacity: an editorial comment," (2016) 28 *Journal of Environmental Law* 1, 3.

the past decade, litigation has developed into a core strategy for civil society actors in their efforts to bring about regulatory reform on climate change. Stalled international and domestic regulation has prompted actors to move away from and seek regulatory solutions to climate change beyond traditional treaty, executive and legislative mechanisms. Furthermore, the UNFCCC regime's shift in focus towards the national level, as embodied by the Nationally Determined Contributions (NDC) architecture of the 2015 Paris Agreement, has provided civil society with an additional and concrete basis for holding governments and corporations accountable in domestic courts. Against this backdrop, litigation (at the national and subnational levels) has assumed a new regulatory significance and forms part of the growing trend towards the transnational regulation of climate change.[7]

Regulation is understood here in accordance with Heyvaert's definition of the term as "the deliberate exercise of influence on a target's behaviour (designed to either stabilize or modify this behaviour), performed with a certain degree of authority and persistence."[8] Transnational environmental regulation (TER) is regulation undertaken by a range of actors beyond the nation-state and "characterized by the pronounced and substantive involvement of non-state actors."[9] One of the major catalysts for TER is the proliferation of global environmental risks like climate change.[10] Furthermore, multilateral environmental agreements like the UNFCCC increasingly depend on "non-state actors and transnational networks for the effective articulation and implementation

[7] W.C.G.Burns & H.Osofsky (eds), n6, 20.
[8] Veerle Heyvaert, 'The Transnationalization of Law: Rethinking Law Through Transnational Environmental Regulation' (2017) 6 *Transnational Environmental Law* 2, 208.
[9] Ibid, 206.
[10] Ibid, 207; J.B. Wiener, 'Global Environmental Regulation: Instrument Choice in Legal Context' (1999) 108 *Yale Law Journal* 4.

of their regulatory goals."[11] Regulation is also understood here as "a sub-set of the broader category of governance, which comprises 'all processes and institutions, both formal and informal, that guide and restrain the collective activities of the group.'"[12] More specifically, transnational climate governance occurs when "networks operating in the transnational sphere authoritatively steer constituents towards public goals"[13] such as mitigation and adaptation. This is also alternatively referred to as a *global climate regime complex* and understood in terms of multi-level and multi-spatial networks (i.e. networked governance).[14] These governance networks involve constellations of both state (e.g. government agencies) and non-state actors (e.g. corporations and environmental NGOs) performing regulatory activities both within and beyond the nation-state.[15]

As a form of regulation,[16] climate litigation functions as an integral and constitutive component of transnational climate governance. While not all climate litigation can be considered transnational in scope, many of the high-profile cases selected for discussion in this PhD project involve epistemic communities[17] and transnational networks of climate scientists, courts and ENGO litigants and have a significant or an outsized transnational impact, including the ability to inspire analogous efforts across other

[11] V.Heyvaert, n8, 207.
[12] Ibid, 208; Douglas Kysar, 'Sustainable Development and Private Global Governance' (2005) 83 *Texas Law Review* 7, 2145.
[13] Liliana B. Andonova, Michelle M. Betsill & Harriet Bulkeley, 'Transnational Climate Governance' (2009) 9 *Global Environmental Politics* 2, 56.
[14] Timothy Cadman (ed), *Climate Change and Global Policy Regimes: Towards Institutional Legitimacy* (Palgrave Macmillan, 2013).
[15] L.B.Andonova et al, n13 , 56, 59.
[16] J.Peel & H.M.Osofsky, n6, 26.
[17] Peter Haas defines an epistemic community as a network of professionals with recognised expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue area. They share a set of normative and principled beliefs, which provide a value-based rationale for the social action of community members, causal beliefs, notions of validity, and a common policy enterprise. See Peter M. Haas, 'Introduction: epistemic communities and international policy coordination' (1992) 46 *International Organization* 1, 3.

jurisdictions. These comprise lawsuits that have climate justice and rights-based claims at their core, such as NGO-driven public interest litigation in *Urgenda v The Netherlands*[18] and *Juliana et al v USA.*[19] In addition, this PhD project largely considers the knowledge-based activities of scientific, judicial and litigant *networks* and understands them as actors involved in transnational climate governance due to their important epistemic contributions to climate science and climate litigation.

While many climate change lawsuits have diverse motivations and aims, pioneers in this area of environmental law research, Hari Osofsky and Jacqueline Peel, opine that they fall into two overarching categories: i) disputes over the appropriate role of governments in regulating greenhouse gas (GHG) emissions, and; ii) efforts to force major corporate emitters to reduce their emissions.[20] They argue that climate litigation is both a catalyst for regulation and itself a new form of regulation.[21] These legal scholars have been predominantly concerned with mapping the direct and indirect regulatory role of climate litigation, mainly in the United States and Australia.[22]

Several important findings emerge from their extensive study of these two jurisdictions. First, they develop a useful typology of the direct and indirect regulatory impacts of climate change litigation. The former category involves judicial acts of interpreting and extending the application of environmental legislation and common law obligations to encompass climate harms and the regulation of GHG emissions, as exemplified by the

[18] *Stichting Urgenda v Government of the Netherlands (Ministry of Infrastructure and the Environment)* ECLI:NL:RBDHA:2015:7145, Rechtbank Den Haag, C/09/456689/HA ZA 13-1396.
[19] *Kelsey Cascadia Rose Juliana et al. v. United States of America et al* (2016) Case No. 6:15-cv-01517-TC, 4.
[20] J.Peel & H.M.Osofsky, n6, 26.
[21] Ibid; J.Peel & H.M.Osofsky, n6; Hari M. Osofsky & Jacqueline Peel, *Climate Change Litigation: Regulatory Pathways to Cleaner Energy* (CUP 2015).
[22] J.Peel & H.M.Osofsky, n6.

landmark US Supreme Court ruling in *Massachusetts v EPA*.[23] Similarly, in the recent Dutch *Urgenda* lawsuit, the Hague District Court extended the application of tort law to the regulation of greenhouse gas (GHG) emissions.[24] Indirect regulatory influences of climate litigation include raising public awareness about climate change, providing an incentive for corporate actors to adopt climate friendly practices to avoid lawsuits, motivating social movements to campaign for climate action, and influencing governments to adopt regulation.[25] Secondly, they identify an increasing focus on adaptation in both jurisdictions, particularly Australia.[26] Finally, they argue that common law tort suits have a limited direct regulatory impact as compared with statutory suits, with judicial acts of statutory interpretation often having both direct and indirect policy consequences.[27] They further posit that many climate change cases filed around the world following the adoption of the Paris Agreement have involved rights claims and are thereby constitutive of a 'rights turn' in climate litigation.[28]

Academic literature on climate litigation is in a growth phase and remains largely concentrated in the hands of legal scholars.[29] Conducting a systematic review of 130 articles on climate change litigation from law and the social sciences from 2000 to 2018, Setzer and Vanhala identify four key themes in the literature to date: i) the relationship between climate change litigation and legislation; ii) the relationship between litigation, scales and time; iii) the relationship between climate litigation and science; and iv) the

[23] J.Peel & H.M.Osofsky, n6, 154.
[24] *Urgenda*, n18.
[25] J.Peel & H.M.Osofsky, n6, 157.
[26] Ibid, 171-172.
[27] Ibid, 173.
[28] Jacqueline Peel & Hari M. Osofsky, 'A Rights Turn in Climate Change Litigation?' (2018) 7 *Transnational Environmental Law* 1.
[29] Joana Setzer & Lisa C. Vanhala, 'Climate change litigation: A review of research on courts and litigants in climate governance' (2019) 10 *Wiley Interdisciplinary Reviews: Climate Change* 3.

relationship between climate litigation and human rights.[30] Building on Peel and Osofsky's work, a large cluster of legal studies exemplifies the first of these themes and examines the influence of climate litigation on regulation. These have tended to focus on: i) how litigation is reshaping climate change policymaking at multiple levels of governance; ii) how litigation serves to raise awareness about the plight of communities vulnerable to and affected by climate change and; iii) whether courts are increasingly assuming a *de facto* gap-filling regulatory role in the face of executive and legislative inaction.[31] Of the four themes identified by Setzer and Vanhala, research examining the relationship between climate litigation and climate science remains among the most under-developed. My research seeks to bridge this significant knowledge gap by examining the relationship between climate science and climate law in both pre-litigation and litigation contexts. The following section discusses my research question and provides a rationale for the project's focus on the relationship between climate science and climate litigation. Section III outlines my central claim and the academic contribution my PhD project seeks to make to the literature on transnational environmental law and climate litigation. Section IV specifies the methods that I employ to answer the research question. The fifth and final section provides an overview of the structure of the thesis and a breakdown of the chapters.

[30] Setzer et al, n29, 7-11.

[31] Brian J. Preston, 'The Contribution of Courts in Tackling Climate Change' (2016) 28 *Journal of Environmental Law* 1; Lisa Vanhala & Chris Hilson, 'Climate Change Litigation: Symposium Introduction' (2013) 35 *Law & Policy* 3; Lisa Vanhala, 'The comparative politics of climate change litigation' (2013) 2 *Environmental Politics* 3; David B. Hunter, 'The Implications of Climate Change Litigation: Litigation for International Law-Making' in W.C.G. Burns and H.M. Osofsky (eds), n5; David Markell & J.B.Ruhl, 'An Empirical Survey of Climate Change Litigation in the United States' (2010) 40 *Environmental Law Reporter* 10644; Jolene Lin, 'Climate Change and the Courts' (2012) 32 *Legal Studies* 1.

II. Research Question & Project Rationale

The overarching research question that I have chosen to engage with in my PhD project is as follows: *What is the role of climate science in shaping climate litigation?* To address and unpack this question, I engage in three main tiers of analysis, looking at how the knowledge base on climate change is: i) *produced* and *synthesised* by the IPCC; ii) *translated* and *certified* by domestic courts, and; iii) *mobilised* and *transformed* by litigants.

Why focus on the relationship between climate science and climate litigation?

The role of climate science and expertise in shaping the dynamics of climate litigation is a topic that has largely been neglected by the legal literature on the subject. While several academic studies on climate change consider the role of climate science in litigation,[32] work that specifically examines the role that climate science plays in shaping climate litigation is relatively rare. Graeme Hayes investigates how social movement actors mobilise expert testimonies in British and French criminal trials involving climate change issues.[33] Elizabeth Fisher looks at academic expertise in climate change litigation, identifying factors behind the growth of legal academic interest in the issue and its implications for future scholarship.[34] Sophie Marjanac and Lindene Patton contend that emerging 'extreme weather event attribution science' may

[32] Jacqueline Peel, 'Issues in Climate Change Litigation' (2011) 5 *Carbon and Climate Law Review* 1; Hari M. Osofsky, 'The Intersection of Scale, Science, and Law in Massachusetts v. EPA' (2007) 101 *Proceedings of the Annual Meeting (American Society of International Law)* 62; Josephine van Zeben, 'Establishing a Governmental Duty of Care for Climate Change Mitigation: Will *Urgenda* Turn the Tide?' (2015) 4 *Transnational Environmental Law* 2; Geetanjali Ganguly, Joana Setzer & Veerle Heyvaert, 'If At First You Don't Succeed: Suing Corporations for Climate Change' (2018) 38 *Oxford Journal of Legal Studies* 4.

[33] Graeme Hayes, 'Negotiating Proximity: Expert Testimony and Collective Memory in the Trials of Environmental Activists in France and the United Kingdom' (2013) 35 *Law & Policy* 3, 209.

[34] Elizabeth Fisher, 'Climate Change Litigation, Obsessions, and Expertise: Reflecting on the Scholarly Response to *Massachusetts v. EPA*' (2013) 35 *Law and Policy* 3, 236.

become a driver of climate litigation, making it increasingly possible to satisfy legal causation (i.e. foreseeability) requirements and reframe governmental and corporate duties of care in relation to climate adaptation.[35] With these notable exceptions, there is no legal scholarship that specifically examines how scientific and other bodies of expert knowledge on climate change are mobilised by actors through transnational networking initiatives and climate litigation. Moreover (and except for Marjanac and Patton), these studies do not examine the nexus and relationship between the production of climate science, its use in pre-litigation (i.e. within transnational judicial and litigant networks) and litigation (i.e. before domestic courts). By and large, they also do not consider the ways in which parallel developments in climate science and climate litigation influence one another and are mutually serving to transform existing legal and scientific frameworks on climate change. It is precisely this under-theorised dynamic that I seek to map.

Climate litigation is fertile ground for examining how particular knowledge claims and narratives of climate change are produced, legitimated, and empowered. There is growing interest not only in how the technoscientific narrative of climate change is produced by the Intergovernmental Panel on Climate Change (IPCC), but also how it is imbued with legitimacy by policymakers, courts and litigants. In short, what are the wider implications of a dominant technoscientific narrative for policymaking and devising regulatory responses to climate change? Focusing on climate litigation and the intersections between scientific, policy, and legal processes allows us to interrogate and understand how particular knowledge claims achieve legitimacy, shape and influence

[35] Sophie Marjanac & Lindene Patton, 'Extreme weather event attribution science and climate change litigation: an essential step in the causal chain?' (2018) 36 *Journal of Energy & Natural Resources Law* 3.

policies and regulatory responses, or ultimately fail. I argue that an examination of the relationship between the IPCC, national courts and litigants provides pertinent insights in this regard. Much scholarly attention has already been devoted to examining the role of courts with respect to climate change. Courts are being thought of as "battlefields in climate fights"[36] and, as Osofsky notes, "have become a critical forum in which the future of greenhouse gas emission regulation and responsibility are debated."[37]

Northern industrialised states have a built-in structural preference for evidence-based policymaking (as driven by the informational demands of risk assessment and management procedures) on a host of issues including, but not limited to climate change. The privileging of science and technology or 'STEM' research as a knowledge base for policymaking and regulation is not new and has long been the norm within these societies. However, as Von Storch points out, "it is no longer being scientific that is important. It is the *political utility* of knowledge claims that carry the day. Such claims must also be imbued with social acceptance and social utility."[38] Litigation can be regarded as one important mechanism through which climate change knowledge claims and climate science narratives are gaining wider social utility.

The deep political divisions on climate change have *epistemic* foundations. The battles being waged over climate change regulation are, at their core, epistemic ones, whereby competing knowledge claims are vying for supremacy. While it would prima facie

[36] John Schwartz, 'Courts as Battlefields in Climate Fights,' *New York Times* (27 January 2010) <http://www.nytimes.com/2010/01/27/business/energy-environment/27lawsuits.html> accessed 5 July 2017.
[37] Hari M. Osofsky, 'The Continuing Importance of Climate Change Litigation' (2010) 1 *Climate Law* 3.
[38] Hans Von Storch, Armin Bunde & Nico Stehr, 'The Physical Sciences and Climate Politics' in John S. Dryzek, Richard B. Norgaard & David Schlosberg (eds), *The Oxford Handbook of Climate Change and Society* (OUP 2011) 123.

appear that the general question on the anthropogenic causes of climate change has been settled by the IPCC's scientific consensus,[39] skepticism about the pronouncements and continuing role of climate science and the IPCC prevails in the United States. This skepticism also permeates some US climate litigation scenarios, which I characterise as another site of knowledge contestation within the broader climate change regime complex.[40] My PhD thesis seeks to elucidate the ways in which key actors in climate litigation proceedings mobilise climate science and expertise. Much of the existing scholarship on the relationship between science and law in environmental litigation understandably focuses on the judicial treatment of scientific evidence.[41] In contrast, my PhD project adopts a wider gaze and investigates not only how courts co-produce and legitimate the knowledge base on climate change, but also how other key actors in climate litigation proceedings harness climate science to argue their claims and lobby for regulatory change.

Climate litigation is of interest as a new medium through which knowledge claims and narratives about climate change are pitted against one another and locked in a struggle for legitimacy. Climate science has been subject to both scholarly critiques of epistemic hegemony and monopolism from the left (including constructivist fields such as Science and Technology Studies or 'STS') and denialist challenges from right-wing,

[39] IPCC, 'Fifth Assessment Report: The Physical Science Basis' (2013) < https://www.ipcc.ch/report/ar5/wg1/> accessed 12 May 2019.

[40] Climate change governance is alternatively referred to as a *global climate regime complex* and understood in terms of multi-level and multi-spatial networks (i.e. networked governance). Timothy Cadman (ed), *Climate Change and Global Policy Regimes: Towards Institutional Legitimacy* (Palgrave Macmillan, 2013).

[41] Sheila Jasanoff, 'Serviceable Truths: Science for Action in Law & Policy' (2015) 93 *Texas Law Review* 1723; J.van Zeben, n32; J.Peel, n32; H.M. Osofsky, n37; Brian J. Preston, 'Climate Change Litigation (Part 1)' (2011) 1 *Climate Change Law Review* 3.

conservative and libertarian movements in the US.[42] These actors have all levelled accusations against the IPCC and its collaborators (climate scientists generally from Northern universities or institutions) with respect to methodological deficiencies, concentrating their ire on imperfect data derived from Global Circulation Models (GCMs) and prevailing scientific uncertainties. The IPCC has also faced criticism for its lack of geographical diversity (particularly for under-representing developing country perspectives) and gender diversity and representativeness. Climate science and the work of the IPCC is therefore plagued by this double-bind, perpetually failing to satisfy critics from both the left and right sides of the political spectrum. Examining climate litigation allows us to get a sense of the various ways in which climate science narratives are being mobilised and transmitted through legal proceedings by scientists, courts and litigants to influence regulatory reform on climate change.

I examine and unpack this undertheorised epistemic-political dimension of climate change litigation in order to determine the following: i) does the use of climate science affect legal processes such as litigation and adjudication; ii) is the judicial treatment of climate science and IPCC reports unique or markedly different from the judicial treatment of scientific evidence in other cases; and iii) might the IPCC's scientific consensus and epistemic authority present opportunities for other actors such as courts and litigants to rethink and reshape climate change governance?

[42] See Naomi Oreskes & Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (Bloomsbury Press 2011); Sheila Jasanoff, 'A New Climate for Society' (2010) 27 *Theory, Culture & Society* 233.

III. Central Claims

Based on a review and analysis of climate change litigation, I argue that through the production, certification and use of climate science in litigation, scientists, courts and litigants are *co-producing* a new and emergent transnational body of case law and legal practice. This is not an enacted body of law in the traditional sense, but comprises "convergent currents of foreign statutes, foreign constitutional provisions and foreign precedents [that] sometimes add up to a body of law that has its own claim on us as 'law in the world.'"[43] My claim is not about a *universal* law of climate change, in the sense of emerging norms of customary international law. It is therefore premised on the understanding that not *all* states have to be participants in its development. However, this does not negate the fact that a transnational body of climate change legal practice and jurisprudence is nonetheless emerging because of significant inter-jurisdictional borrowing and cross-fertilisation between courts and litigants from many different countries.

I also do not claim that this body of transnational climate change case law and practice is absolute and leaves no scope for local differentiation. This position aligns with and is supported by a prominent strand of environmental legal scholarship which emphasises the simultaneous presence of transnationalism and localism in transboundary legal developments, rather than presenting such developments as mutually exclusive.[44] Scholars of transnational environmental law like Penca espouse the idea of 'transnational localism,' which is defined as the "reinforcement of local-

[43] Jeremy Waldron, 'Foreign Law and the Modern Ius Gentium' (2005) 119 *Harvard Law Review* 129, 132; Neil Duxbury, 'The Law of the Land' (2015) 78 *Modern Law Review* 1, 41.
[44] Jerneja Penca, 'Transnational Localism: Empowerment through Standard Setting in Small-Scale Fisheries' (2019) 8 *Transnational Environmental Law* 1.

specific approaches (reflecting local ecologies, values, and socio-economic specificities) within a transnational structure that provides support and recognition."[45] Concurrently tethered to both international and domestic legal (UNFCCC/Paris Agreement) and epistemic frameworks (IPCC science), nationally-situated climate litigation aptly exemplifies this idea of transnational localism.

I have overwhelmingly analysed climate litigation in states from both the Global North and South that are *constitutional democracies*,[46] which makes comparisons between them possible. I have therefore consciously excluded discussions of climate litigation in authoritarian states like China because they are inapt comparators.[47] This is because Chinese climate litigation is currently limited to "contract-based civil actions steered by the government's low-carbon policies" and therefore does not currently resemble the forms of strategic climate litigation that exist in other jurisdictions.[48] Rather, my claim is more focused on a *transnational* climate change case law which is being developed by and between a cluster of constitutional democratic states (i.e. via non-hierarchical, horizontal relationships) through climate

[45] J.Penca, n44, 143.
[46] 'Constitutional democracy' is understood here as a system of government by the people who choose their representatives through free and fair elections and where the exercise of public authority by elected representatives is organised and regulated in accordance with a constitution (whether written or unwritten). A constitution imposes a set of necessary constraints (e.g. checks and balances; separation of powers etc.) on the exercise of public authority to prevent abuses of power. It is also a system of government in accordance with the rule of law, which is designed to ensure the protection of minority rights; See Laura Burgers, 'Should Judges Make Climate Change Law?' (2020) 9 *Transnational Environmental Law* 1; J.van Zeben, n32.
[47] For a good discussion of Chinese climate litigation, see Yue Zhao, Shuang Liu and Zhu Wang, 'Prospects for Climate Change Litigation in China' (2019) 8 *Transnational Environmental Law* 2. Similarly, for a discussion of Russian climate litigation see Y. Yamineva, 'Opportunities for Climate Litigation in Russia: The Impossibility of the Possible' in M. Moise Mbengue and F. Sindico (eds.) Comparative Climate Change Litigation: Beyond the Usual Suspects (Springer, forthcoming). These scholars have all observed that courts do not play a significant role in legitimating concerns about climate change as their counterparts in the US, EU and Australia.
[48] Y.Zhao et al, Ibid, 349.

litigation, particularly by reference to IPCC assessments and the Paris Agreement which are universally applicable common denominators.

The new and emerging body of legal practice and jurisprudence emanating from recent iterations of climate litigation is a hybrid byproduct of interactions between science and law; what Marilyn Strathern calls an *epistemic transfer* affecting the very knowledge base(s) of both.[49] Experts talk to each other to solve problems which cannot be addressed by one approach alone. This is not just interdisciplinarity, which still implies bounded disciplines, but a form of 'transdisciplinarity' – the idea that disciplinary boundaries can be transcended altogether to produce hybrid outcomes in response to a problem of collective concern.[50]

Constitutive elements of transnational climate change case law

These transdisciplinary interactions are contributing to the transnationalisation of law on climate change. Marking a departure from traditional modes of lawmaking, this shift in climate change governance is consistent with Fisher, Scotford and Barritt's claim that climate change is a polycentric problem which is legally disruptive. [51] Consequently, they argue that "climate change-related disputes do not fit easily into existing doctrinal paradigms" such as standing, human rights and tort law.[52] I argue that one response or side-effect of this legal disruption has been the emergence of a new transnational body of legal practice and jurisprudence on climate change.

[49] Marilyn Strathern, 'A Community of Critics? Thoughts on new knowledge' (2006) 12 *The Journal of the Royal Anthropological Institute* 1, 196.
[50] Ibid.
[51] Elizabeth Fisher, Eloise Scotford & Emily Barritt, 'The Legally Disruptive Nature of Climate Change' (2017) 80 *Modern Law Review* 2, 173.
[52] Ibid, 189-190.

The common constitutive features of transnational climate change case law and legal practice include the following: i) common litigants or parties: repeat players with a multinational presence and personality such as fossil fuel companies and environmental NGOs; ii) the invocation and cross-citation of foreign precedents by certain courts and litigants: this is currently most apparent in constitutional contexts[53]; iii) universal membership of the Paris Agreement and its invocation in several climate change lawsuits post-2015[54] and; iv) reliance upon and application of universal climate science as exemplified by the fact that many of these lawsuits feature IPCC assessments, which have become a common denominator and evidentiary baseline. The latter involves "processes of doctrinal evolution"[55] whereby judges are applying IPCC climate science to transform, update and adapt existing legal doctrines to address climate change. It is also characterised by litigants' deployment of structurally convergent and recurrent patterns of climate science-backed legal argumentation with respect to causation, fundamental rights violations and the public trust doctrine.

What are the regulatory implications of this emergent transnational climate change case law? Are judges making decisions that are regulatory in nature (i.e. policy)? One reason legal scholars might be concerned about this development may be the significant implications for state sovereignty and the separation of powers in constitutional

[53] Judges are increasingly paying attention to climate change developments in jurisdictions around the world. Cases like *Juliana et al v USA* have paved the way and inspired analogous constitutional lawsuits elsewhere. See *Kelsey Cascadia Rose Juliana et al. v. United States of America et al* (2016) Case No. 6:15-cv-01517-TC, 4. Other examples include the Pakistani case, *Ashgar Leghari v Federation of Pakistan* (W.P. No. 25501/2015) and the Colombian lawsuit *Future Generation v Ministry of the Environment & Others*, Sabin Center for Climate Change Law: Columbia Law School, 'Climate Case Chart' (2018) <http://climatecasechart.com/non-us-case/future-generation-v-ministry-environment-others/> accessed 23 April 2019.

[54] Anna-Julia Saiger, 'Domestic Courts and the Paris Agreement's Climate Goals: The Need for a Comparative Approach' (2020) 9 *Transnational Environmental Law* 1.

[55] E.Fisher et al, n51, 190.

democracies.[56] Another is that it potentially constitutes a new form of climate change regulation. My research is primarily concerned with the latter. Members of the public are beginning to make interventions on climate change by turning to national courts and using litigation to drive regulatory change through science-led advocacy and argumentation about state and corporate responsibility for climate change. This may be partly due to the relatively less corruptible character of the judiciary in many countries, including the US where the executive and legislature remain highly susceptible to lobbying influence and regulatory capture by special interests.[57] Against this backdrop, it is therefore unsurprising that courts have assumed a new kind of regulatory significance for private citizens and civil society actors as alternative fora through which to advance pro-regulatory climate (i.e. mitigation and adaptation) agendas. It is not entirely borne out that such judicial interventions are inherently undemocratic since courts are directly responding to citizens' demands for climate action and remediation, particularly where legislative and executive responses have been suboptimal or deficient.[58]

I argue that this is a new kind of regulatory intervention in the face of an issue as unprecedented and consequential as climate change. Climate litigation may be driving the creation of a new public sphere which currently looks exclusively technocratic, but also highlights the inception of a new kind of politics. Swedlow posits that when it comes to environmental management, we are witnessing a rise of collectivist cultures and a corresponding decline of individualistic cultures.[59] There is some evidence for the

[56] See J.van Zeben, n32; Laura Burgers, 'Should Judges Make Climate Law?' (2020) 9 *Transnational Environmental Law* 1.
[57] J.Watts, n2.
[58] L.Burgers, n56, 2, 21.
[59] Brendan Swedlow, 'Three Cultural Boundaries of Science, Institutions and Policy: A Cultural Theory of Boundary Work, Co-production and Change' (2017) 34 *Review of Policy Research* 839.

former in terms of the proliferation of environmental groups which vigorously oppose industrial activity (i.e. logging, deforestation, mining, and fossil fuel exploitation). Indeed, as will be shown in Chapter Six, ENGOs have emerged as a powerful and prominent category of climate litigant, bringing enormous pressure to bear on governments and enterprises around the world to comply with their climate change obligations and provide compensation and adaptation-related redress for climatic harms.

Furthermore, the triangulated dynamic of boundary work and knowledge co-production between climate scientists, national courts and litigants signifies a momentous shift in transnational climate change governance. This co-produced transnational body of jurisprudence and legal practice emerging out of newer waves of climate litigation is also resulting in the enforcement of international law in some instances (i.e. state obligations under the UNFCCC, Paris Agreement, European Convention on Human Rights etc. as exemplified by the *Urgenda* decisions,[60] *Plan B Earth v Secretary of State (Heathrow Third Runway Case)*[61] and *Greenpeace Norway v Ministry of Petroleum and Energy.*[62] I argue that this is a distinct new development and an emerging body of transnational legal practice and jurisprudence on climate change because of the high degree of structural convergence and cross-fertilisation between climate change cases across different jurisdictions. This specifically involves the recurrent judicial validation of IPCC assessments and strikingly similar patterns of argumentation employed by

[60] *Urgenda Foundation v Netherlands ('Urgenda I'),* n19; *Netherlands v Urgenda Foundation* (The Hague Court of Appeal, 200.178.245/01, 9 October 2018) ('*Urgenda II'*). For an unofficial English translation of the decision see, <http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2018/20181009_2015-HAZA-C0900456689_decision.pdf>; *Netherlands v Urgenda Foundation* ('*Urgenda III'*)(The Supreme Court of the Netherlands, 19/00135, 20 December 2019) [unofficial English translation]; See A-J. Saiger, n54.
[61] *Greenpeace Norway v Ministry of Petroleum and Energy* (Borgarting Court of Appeal, No. 18-060499ASD-BORG/03, 23 January 2020).
[62] *R (on application of Plan B Earth and Others) v Secretary of State for Transport* [2020] EWCA (Civ) 214.

litigants around salient issues like causation, fundamental rights and public trust which are based on identical or analogous science (i.e. IPCC or national assessments).

Mapping these developments in climate litigation around the world, I also argue that the recurrent judicial treatment and invocation of IPCC assessments amounts to a tacit admission by some courts in certain high profile climate change cases that all physical science on climate change (which is IPCC-accredited) is potentially relevant and admissible. In common law jurisdictions like the US, this might significantly disrupt traditional legal rules of evidence and procedure which are typically geared towards resolving legal questions that arise in a case and are contingent on its specific factual scenario. In climate litigation, general and specific causal enquiries remain inextricable and on a continuum. More specifically, the empirical reality of climate change is universal, which means that many climate change cases are likely to unfold along a similar causal trajectory and then telescope into specific causal enquiries involving attribution of localised harm. Chapters Four and Five on the judicial treatment of climate science examine this dynamic between general and specific causation enquiries. Critically, in contrast to other areas of litigation, climate litigation implicates and is always tethered to both universal scientific (IPCC assessments) and legal frameworks (i.e. the UNFCCC regime and Paris Agreement). In this regard, it lends itself more easily to a transnational framing as a body of global case law and precedent that has wider resonance and application across jurisdictions despite the structural-legal differences between them (i.e. common law versus civil law countries). Chapters Four to Six explore and map these dynamics in considerable detail.

On a crude reading, this recent triangulation of epistemic-regulatory authority between the IPCC, national courts and litigants may be considered a capitulation to and victory for technocracy. However, what these various actors in climate litigation are doing also goes beyond boundary work, since there is an outward expansion of disciplinary boundaries into a new sphere of hybridised knowledge-making and regulation. I propose that these actors are in fact participating in the creation of a new *conceptual* space that is not purely technocratic. Rather, it is also a domain of *collective action* and a new kind of climate politics, because civil society litigants are harnessing and applying the knowledge that is produced and certified by the IPCC and courts, respectively, to drive regulatory change outside traditional legislative and executive processes. This is not inherently antithetical to democracy. Rather, it may be considered a new and innovative way of meaningfully responding to the demands of the *demos* for climate action and remediation. Indeed, recent scholarship on climate litigation argues that within the specific context of constitutional democracies, the climate litigation trend "is likely to influence the democratic legitimacy of judicial lawmaking on climate change, as it indicates an increasing realization that a sound environment constitutes a *constitutional* matter and is therefore a pre-requisite for democracy [emphasis added]."[63]

IV. Research Methods

In order to address my research question, I employ an interdisciplinary and mixed methods approach.

[63] L.Burgers, n56, 2.

Use of an STS Framework

First, my research establishes a theoretical framework for analysing knowledge production on climate change. To that end, it draws upon social science scholarship, mainly STS and constructivist studies of science, which have developed useful analytic categories and tools for understanding the knowledge work of organisations at the science-policy interface such as the IPCC. These include, *inter alia*, the Latourian framework of Actor Network Theory (ANT) and concepts like boundary organisation, boundary work, hybrid management, and co-production.[64]

I use this STS-constructivist framework to analyse the knowledge practices of the IPCC, domestic courts and climate litigants both within networking contexts outside the courtroom and formal legal proceedings within the courtroom. I make novel use of this interdisciplinary framework to argue that climate science is being *co-produced* by these key actors at multiple sites. Firstly, it is being co-produced within the IPCC by scientific and interdisciplinary working groups that include scientists, social scientists, legal and policy professionals, through iterative assessment cycles. I term this '*science-policy co-production*.' Secondly, climate science is also being co-produced through various applications in legal settings such as UNFCCC COPs and, more significantly, within domestic courts through its integration into legal claims by climate litigants. I characterise this nascent development as '*science-law co-production*.' Finally, climate science is being evaluated and certified by courts and judges who are using IPCC assessments as an epistemic yardstick to recalibrate, adjust and ratchet up ambition with respect to national mitigation policies (i.e. emissions

[64] David H. Guston, "Boundary Organizations in Environmental Policy and Science: An Introduction," (2001) 26 *Science, Technology, & Human Values* 4, 400; Clark Miller, "Hybrid Management: Boundary Organizations, Science Policy, and Environmental Governance in the Climate Regime," (2001) 26 *Science, Technology, & Human Values* 4, 478; S.Jasanoff, n1.

reduction targets). In doing so, they are engaging in '*science-policy-law co-production*.'

Fig 1. Trans-disciplinary Co-production of Climate Science

WHO	WHAT	WHERE
Climate scientists; social scientists; policymakers; legal professionals	Science-policy co-production	IPCC
IPCC and legal professionals	Science-policy-law co-production	UNFCCC; SBSTA; COPs
Administrative decision-makers; tribunal members; judges	Science-law co-production; Science-policy-law co-production	Tribunals; Domestic Courts
Climate litigants (Civil society; ENGOs; youth claimants)	Science-law co-production	Transnational networks; Domestic Courts

I also draw on the existing social science and legal literature on the judicial treatment of expert evidence in environmental litigation, a topic that has been extensively written about by STS scholars.[65] To a lesser extent, I also draw upon the philosophical literature on science[66] to contextualise my discussion of STS-constructivist perspectives on science for policymaking. This STS framework is outlined in detail in Chapter Two, which explains the main applications and uses of key STS concepts in my PhD project.

My working definition of climate litigation

Climate litigation is a broad church and a rapidly evolving phenomenon which implicates many different areas of law and "refers to lawsuits in which climate change

[65] Sheila Jasanoff, *Science at the Bar*: *Law, Science, and Technology in America* (Harvard University Press 1997).
[66] Here I refer to the body of work by Karl Popper, Thomas Kuhn and Michael Polanyi.

and its impacts are either a contributing or key consideration in legal argumentation and adjudication."[67] The dynamic and expanding nature of climate litigation accounts for the absence of a monolithic definition of the term in the existing legal literature. Rather, scholars have typically put forward their own definitions. For example, Peel and Osofsky characterise climate litigation flexibly as encompassing "cases that take place in quasi-judicial contexts and that reference climate change amid a panoply of issues."[68] While recognising that climate change does not necessarily have to constitute a central component of these cases, their work has largely focused on "cases at the core, which include climate change-specific arguments or judicial analyses referencing climate change."[69] Broadly aligned with this definition is the one advanced by Markell and Ruhl who define "climate change litigation as any piece of federal, state, tribal, or local administrative or judicial litigation in which the party filings or tribunal decisions directly or expressly raise an issue of fact or law regarding the substance or policy of climate change causes and impacts."[70]

In earlier work, I have employed the concept of 'strategic climate litigation' to denote "cases initiated to exert bottom-up pressure on governments ('strategic public climate litigation') or corporations ('strategic private climate litigation') to mitigate, adapt, or compensate for losses resulting from climate change."[71] These cases are in the minority and have received considerable attention from scholars, state actors and non-state actors.[72] Some prominent examples include *Massachusetts v EPA*, *Urgenda v The*

[67] G.Ganguly et al, n32, 843.
[68] J.Peel & H.M.Osofsky, n6, 153.
[69] Ibid.
[70] D.Markell & J.B.Ruhl, n19, 27.
[71] G.Ganguly et al, n32, 843.
[72] Ibid.

Netherlands, *Juliana et al v USA* and *Saul Luciano Lliuya v RWE*.[73] My above definition of strategic climate litigation is employed throughout this PhD project, since all these cases will be the focus of study and have been specifically selected because they contain the most robust substantive discussions on climate science, in the form of IPCC assessments, by courts and litigants. All of them also contain direct references to the terms 'climate change' and/or 'greenhouse gas (GHG) emissions.'

Beyond this cluster of the most high-profile cases, my PhD project also considers lawsuits in which climate change or GHG emissions feature as a secondary or peripheral component. These include administrative lawsuits involving administrative or judicial review, pertaining to the development of new fossil fuel (e.g. coalmine) or renewable energy projects, of which *Gloucester Resources v Minister for Planning* and *Taralga Landscape Guardians v Minister for Planning*[74] constitute salient examples. These cases have also been selected on the basis that they contain a rich discussion and judicial evaluation of IPCC assessments. Thus, my selection of cases for this project is largely guided by the criterion of whether they include a substantial discussion of climate science including IPCC assessments, regulatory science produced by government agencies such as national scientific assessments, or event attribution studies on extreme weather events. In line with Markell & Ruhl, my working conception of climate litigation also broadly and holistically encompasses '*adjudication'* in the sense of administrative or quasi-judicial (i.e. tribunal) and court proceedings, which involve judges or tribunal members presiding over a legal dispute, reviewing evidence, legal claims and argumentation presented by litigants, and arriving at a formally binding

[73] *Massachusetts v EPA* 127 S. Ct. 1438; 549 U.S. 497 (2007); *Urgenda*, n18; *Juliana*, n19; *Saul Luciano Lliuya v RWE* (2017) 20171130 Case No-2-O-28515.
[74] *Gloucester Resources Ltd v Minister for Planning* (2019) 234 LGERA 257; *Taralga Landscape Guardians Inc. v Minister for Planning* (2007) 161 LGERA 1.

decision or ruling. In addition, as discussed above in section III, I mainly focus on climate litigation in *constitutional democracies*. Thus, any observations or claims made throughout my PhD project in relation to the cases discussed may apply to other cases in that category, but are not generalizable to climate litigation writ large.

Use of climate litigation databases

To answer my research question, I draw heavily on primary sources such as case law (e.g. statements of claim, trial transcripts and judgments) and legislation. These derive largely from the Sabin Center for Climate Change Law at Columbia University and the LSE Grantham Institute for Climate Change and the Environment's databases which comprehensively document climate litigation across the globe.[75] The former is heavily relied upon for US cases, since it is the largest repository of US climate litigation. The latter is used to draw upon non-US case law, including cases from Global South jurisdictions, which the Grantham Institute continues to aggregate and expand upon. I undertake a predominantly textual and doctrinal analysis of the statements of claim, trial transcripts and judgments in these cases, relevant academic literature, policy papers, and surrounding media publications.

My research seeks to identify the degree of cross-fertilisation and strategic convergence of ideas, adjudicative methodologies and litigants' advocacy and argumentation techniques across jurisdictions, specifically in terms of their treatment and mobilisation of climate science. It investigates whether courts and litigants in these jurisdictions are beginning to develop a shared normative understanding and a common vocabulary for

[75] Columbia Law School: Sabin Center of Climate Change Law (SCCCL), 'Resources' (2016) <http://web.law.columbia.edu/climate-change/resources> accessed 15 March 2016; SCCCL, "Litigation Charts" < http://web.law.columbia.edu/climate-change/resources/litigation-charts> accessed 25 August 2019.

dealing with climate change issues. It argues that inter-jurisdictional exchanges have become a fixture of transnational climate change governance as best exemplified by transnational judicial and civil society conversations, informational exchanges and knowledge sharing with respect to climate change.

V. Structure of the Thesis

In addition to the introduction (Chapter 1) and conclusion (Chapter 7), my PhD thesis is organised in terms of five major chapters as follows:

Chapter 2: STS-constructivism and its applications to climate science, policy and law

This chapter draws upon STS-constructivist literature to carve out a theoretical framework for analysing knowledge production on climate change, with a focus on the field of climate science and the knowledge practices of the Intergovernmental Panel on Climate Change (IPCC). The chapter will argue that certain constructivist tools and analytic categories offered by STS, such as Bruno Latour's Actor Network Theory (ANT) and Sheila Jasanoff's 'Co-production Idiom,' allow us to better understand climate change knowledge production (i.e. the work of climate scientists and the IPCC) and certification (i.e. litigation and adjudication) as interconnected and complementary processes of inter-institutional epistemic engagement. Focusing on the STS concepts of *boundary work* and *co-production,* the chapter argues that the production of knowledge and a particular scientific-epistemic imaginary of climate change is concurrently taking place at the boundaries of science, politics, and law. The relationship between the IPCC,

the courts, and litigants can therefore be thought of as triangulated, complementary, and mutually reinforcing.

Chapter 3: The IPCC's Synthesis of Climate Science as Applied Knowledge

This chapter uses an STS framework, combining Actor Network Theory (ANT) and the concepts of boundary work and co-production, to analyse knowledge production, specifically the emergence of climate science, its core findings and precepts and its transformation into a knowledge base for policymaking and norm creation through the work of the IPCC. The chapter begins with a discussion of the evolution of climate science into a field of study, its concurrent narrative power and crisis of narrativisation and the nature of climate science advocacy, particularly in terms of the transformation of the climate scientist into an advocate or activist with a recurring role in climate litigation and adjudication. The chapter then employs an ANT lens to unpack the IPCC's knowledge practices, namely its assessment procedures, which culminate in the certification of climate science and the production of a scientific-political consensus. In sum, this chapter employs an STS-constructivist analytical framework, particularly the concepts of boundary work and hybrid management, to map the IPCC's authority, assess its knowledge work and outputs (i.e. assessment reports), and determine its role in and influence on transnational climate change regulation. The chapter concludes by problematising the myths and fictions about the 'pure' nature of climate science and offers an alternative conceptualisation of climate science as an inherently practical body of knowledge. To that end, it offers a bipartite framing of climate science as applied science and trans-science.

Chapter 4: Climate science in US federal courts

Through an application of the STS-constructivist analytic framework outlined in Chapter 2, Chapter 4 examines the role of courts in co-producing and legitimating the knowledge base on climate change. To gain a deeper understanding of the complex dynamics of climate adjudication, my analysis here focuses on the US, since that is where most climate litigation is occurring.[76] It also seeks to determine the ways in which climate adjudication may differ from environmental adjudication writ large given the relatively watertight IPCC scientific consensus. The analysis here is premised on the STS postulate that the legal system generally and courts more specifically play a seminal role in the construction and dissemination of particular public understandings of science and technology and their role in addressing contemporary problems and controversies.[77] The relationship between law and science (and legal and scientific cultures) is one that is mutually constitutive.[78]

The chapter analyses the judicial treatment of IPCC reports as expert evidence in climate litigation proceedings as a crucial mechanism for the certification of climate science and IPCC assessment reports. It examines the ways in which courts "redraw the lines of power and authority"[79] in climate litigation proceedings by privileging particular expert accounts while excluding others, as best exemplified by *Massachussetts v EPA*. Federal courts in the US are increasingly assuming responsibility as key actors in the reinforcement, validation, and dissemination of the IPCC's expert vision of and scientific consensus on climate change. In this regard, the chapter discusses the recent contribution of some US federal district (i.e. trial) courts towards the emergent transnationalisation of climate change jurisprudence. To that end, it engages in an in-

[76] D.Markell & J.B.Ruhl, n31.
[77] S.Jasanoff, n65, xvi.
[78] Ibid, 8.
[79] Ibid, xv-xvi.

depth discussion of the largely receptive and favourable judicial treatment of climate science in post-Paris climate litigation in *Juliana et al v USA* and *City of Oakland v BP*, which are pertinent examples of this trend. It argues that while US courts have not deliberately sought to contribute to the transnationalisation of climate change case law, US case law nonetheless remains a major reference point for legal scholars, courts and litigants in other constitutional democracies. The transnationalisation of climate change case law can therefore be attributed to this wider uptake and utilisation of US climate change cases like *Massachusetts* and *Juliana* by these actor networks.

Chapter 5: The science-law interface and the transnationalisation of climate adjudication

This chapter examines the role of domestic courts in the transnationalisation of climate law, with a focus on non-US climate litigation and adjudication. It contends that judges in constitutional democracies are contributing to the transnationalisation of climate jurisprudence and law through: i) less formal networked interactions in pre-adjudicative settings outside the courtroom such as conferences, and; ii) direct and formal adjudication in courtrooms through their recurrent treatment and evaluation of climate science, particularly IPCC assessments or national analogues. Domestic courts are often acting in concert across jurisdictions, both through direct cross-citation and sometimes unconsciously, to produce interpretations of climate science that appear to be structurally convergent or largely harmonious with one another. Such judicial interactions and mediations are also transforming IPCC assessments into a usable body of knowledge for litigation and spurring the development of newer waves of climate science. Critically, this chapter posits that this judicial synthesis of science and law – an example of hybridised and transdisciplinary knowledge work – both within and outside the courtroom is resulting in the production of soft law frameworks and jurisprudence

which are constitutive components of an incipient *transnational climate change case law*. It is argued that the adoption of the Paris Agreement in 2015 and successive IPCC outputs (e.g. the Special Report on 1.5°C warming) have served to reinforce this dynamic of judicial transnationalism on climate change.

Chapter 6: Litigant networks and the transnationalisation of climate law

This chapter examines the ways in which litigants harness and mobilise climate science in climate litigation. It argues that civil society, particularly environmental NGOs, have become a powerful category of climate litigant and are combining technoscientific, rights- and justice-based framings of climate change in new and innovative ways to advance pro-regulatory (both mitigation and adaptation) agendas through climate litigation. ENGOs around the world are collaborating strategically through highly developed and sophisticated actor networks to bring domestic lawsuits against governments and corporations under the rubric of the Paris Agreement (i.e. international law), constitutionalised human rights, public trust and intergenerational equity. Critically, IPCC and analogous national scientific assessments constitute the common epistemic foundation of their claims, which are consequently characterised by striking structural similarities. This is most apparent in the context of statutory lawsuits involving approvals for fossil fuel development projects or pushing for higher ambition in terms of national mitigation targets, as well as human rights and public trust claims filed by youth plaintiffs. More specifically, litigants' strategic fusion of climate science with these existing areas of law or legal doctrines is generative of a range of boundary objects, which are the constitutive components of an emergent transnational common law of climate change. These comprise what I term 'endangerment narratives,' the standardised climate impact assessment and the 'future generation lawsuit.'

CHAPTER TWO

STS-constructivism and its Applications to Climate Science, Policy and Law

I. Introduction

In this PhD project, I argue that climate science is being generated through transdisciplinary co-production between the domains of science, policy and law and the key actors steering this process include climate scientists, domestic courts and climate litigants. The byproduct of these co-productive dynamics is an emergent transnational and common body of legal practice and jurisprudence on climate change, as illustrated in Chapters Five and Six. This chapter outlines the Science and Technology Studies (STS) framework that I apply throughout this PhD project to make and substantiate this argument. To that end, I specifically explain how the use of certain key STS methodologies, such as Bruno Latour's Actor Network Theory (ANT)[1] and Sheila Jasanoff's 'Co-production Idiom,' enables us to map and understand the production and synthesis of climate science as *transdisciplinary co-production* between the domains of science, policy and law at multiple sites of governance, namely the IPCC, UNFCCC, and domestic courts.

The observation that scientific knowledge cannot simply 'reflect' nature, but must necessarily translate, represent and to some degree actively construct our conceptions of the 'natural world,' is broadly accepted today.[2] Assumptions about the fixity and

[1] As a project, ANT involves a constructivist-methodological orientation towards accounting for the (behind-the-scenes) sociological production of science. Unlike philosophers of science, STS and ANT scholars posit that a sociological study of science is entirely possible. See Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (OUP 2005) 89-93; Sheila Jasanoff, *States of Knowledge: The Co-production of Science and Social Order* (Routledge 2004) 2.

[2] Construction implies that artificiality and reality march in step. The term social is used to deploy the associations that have rendered some state of affairs solid and durable (e.g. a scientific fact). As a project, ANT involves a constructivist-methodological orientation towards accounting for the (behind-the-scenes)

determinacy of science have been convincingly challenged and deconstructed. That scientific theoretical frameworks and propositions are constantly changing and being renegotiated through processes of evolution[3] or revolution[4] has also been acknowledged.[5] However, the idea of science as objective, value-free, disconnected from particular social and political contexts, and therefore universal, is still subscribed to by lay-publics and policymakers. The persistence of scientism – the notion that there is in an inherent division between facts and values[6] – indicates a disjuncture between certain academic schools of thought[7] and policymaking institutions on the nature and role of science in contemporary societies. Debates within both academia and the public sphere about the nature of science and its role in policymaking are alive and well, continue to be vigorously waged and remain a fixture in political life.[8] Consequently, constructivism has not always managed to successfully bridge the gap between scholarly critique and the applied use of science for policymaking.

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sociological production of science. Unlike philosophers of science, STS and ANT scholars posit that a sociological study of science is entirely possible. Bruno Latour prefers the term 'constructivism' which he argues should not be confused with 'social constructivism.' He observes that 'constructing a fact means that we account for the solid objective reality by mobilising various entities whose assemblage could fail; 'social constructivism' means that we replace what this reality is made of with some other stuff, the social in which it is 'really' built.' Latour defends his brand of constructivism by pointing out that the artificiality of construction does not equate to a deficit in *reality*. See Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (OUP 2005) 89-93; Karl Popper, *The Logic of Scientific Discovery* (Harper Row 1968); Michael Polanyi, *Personal Knowledge: Towards a Post-critical Philosophy* (Routledge 1962); Sheila Jasanoff, 'Is science socially constructed? – And can it still inform public policy?' (1996) 2 *Science and Engineering* 1, 234. The idea of scientific facts as constructed and science as another interpretive framework for the study of nature is not without controversy. The concession by some scientists in this regard has been minor, namely that scientific research agendas are socially determined only to the extent that they depend on external funding and are circumscribed by policy pressures.

3 K.Popper, Ibid.

4 Thomas S. Kuhn, *The Structure of Scientific Revolutions* (University of Chicago Press, 2nd edn, 1970).

5 Tara Skodvin, 'Science-policy interaction in the global greenhouse: Institution design and institutional performance in the Intergovernmental Panel on Climate Change (IPCC)' (1999) CICERO Working Paper No.3.

6 Daniel Lee Kleinman, *Science and Technology in Society: From Biotechnology to the Internet* (Blackwell Publishing 2005) 3.

7 Here I refer to STS and other constructivist critiques of the natural sciences.

8 This debate is emblematic of our current global politics on climate change.

Science and Technology Studies (STS) nonetheless offers valuable frameworks for understanding the interrelationship between science, policy, and law. In my research, I draw upon STS-constructivist analyses of regulatory science and the knowledge practices of boundary organisations (i.e. regulatory scientific institutions).[9] More specifically, my research is predicated on the STS-constructivist idea of science as a socially determined and dynamic knowledge system.[10] The Intergovernmental Panel on Climate Change's (IPCC) knowledge production on climate change has always been a political project rather than a purely scientific one, as indicated by its mission statement that it is a producer of "policy relevant [knowledge]."[11] Climate science, and the IPCC's framing of it, both align with the STS concept of science for policy[12] or 'trans-science,' which is oriented towards addressing questions that transcend pure science and cannot exclusively be answered by it.[13]

I am also sympathetic to the STS view that the social sciences ought to play a role in shaping our understanding of the *socio-economic* dimensions of climate change and contribute to the development of local responses to its impacts.[14] However, my research will problematise the STS-constructivist critique that knowledge production on climate change ought to occur in more pluralistic and democratic settings.[15] It will depart from

[9] Sheila Jasanoff, 'A New Climate for Society' (2010) 27 *Theory, Culture & Society* 233; Oren S. Perez, 'The Hybrid Legal-Scientific Dynamic of Transnational Scientific Organisations' (2015) 26 *The European Journal of International Law* 2.
[10] B.Latour, n1; S.Jasanoff, n1, 263.
[11] IPCC, 'Statement on IPCC Principles and Procedures' (February 2010) < http://www.ipcc.ch/pdf/press/ipcc-statement-principles-procedures-02-2010.pdf > accessed 8 March 2016.
[12] S.Jasanoff, n9.
[13] Alvin M. Weinberg, 'Science and Trans-Science' (1972) 10 *Minerva* 2, 209.
[14] S.Jasanoff, n9; Tim Forsyth, 'Politicizing environmental science does not mean denying climate science nor endorsing it without question' (2012) 12 *Global Environmental Politics* 2; Mike Hulme, *Why we disagree about climate change: Understanding controversy, inaction and opportunity* (CUP 2009).
[15] S.Jasanoff, n9; Jeroen P van der Sluijs, Rinie van Est & Monique Riphagen, 'Beyond consensus: reflections from a democratic perspective on the interaction between climate politics and science' (2010) 2 *Current Opinion in Environmental Sustainability*, 409.

existing STS-constructivist scholarship on the knowledge work of regulatory scientific institutions in two key respects. First, while subscribing to a constructivist understanding of science, my research will seek to highlight the problematic consequences of unquestioningly embracing a constructivist perspective, largely due to its inclination towards relativism and deconstructionism. I will therefore deliver a critique of certain STS-constructivist perspectives on climate science, which are not sufficiently nuanced to capture the complexity of knowledge work surrounding climate change. Second, in doing so, my research will attempt to explore how one can think critically about climate science and the IPCC consensus without undermining their legitimacy as compared with some existing STS-constructivist accounts. In the highly politicised context of climate change, existing STS-constructivist critiques of climate science occasionally appear counterproductive in the face of urgently needed regulation. I therefore seek to theorise the relationship of co-production between the science, politics, and law of climate change in a new way. To that end, my research will highlight both the *uses* and *limitations* of an STS-constructivist framework for understanding climate change knowledge production and its use in pre-litigation and litigation on climate change.

This chapter sets out the core analytic framework that will underpin and inform my PhD project. To that end, it seeks to justify the use of and reliance upon insights and key concepts from constructivist schools of thought such as STS in relation to scientific knowledge production and the use of science as a primary knowledge base for public policy and legal processes such as climate litigation. The next part outlines the epistemological foundations of STS and provides a brief historical overview of the emergence of social constructivism as a school of thought within the social sciences.

Part III sketches the epistemic position of two leading STS scholars, Bruno Latour and Sheila Jasanoff, who have defined the field and whose work on climate change has been particularly influential. It delineates their working conception of science, scientific practice, and the use of science in regulatory domains such as climate change law and policy. Part IV outlines and problematises the STS critique of climate science as articulated by Sheila Jasanoff and others. It identifies the potential limitations and pitfalls of an STS mode of analysis with respect to scientific knowledge production and its use in legal and policy processes pertaining to climate change. In contrast, Part V identifies key concepts and analytic tools developed and employed by STS scholars in their sociological studies of scientific communities and their knowledge practices. It makes a case for the potential utility, application, and contribution of these concepts towards this PhD project. The sixth and final part offers some concluding observations.

II. Epistemological Foundations of STS

Science as social construction

Science and Technology Studies (STS) is a multidisciplinary research program dedicated to studying the history, social organisation, and culture of science and technology and the generalised study of expertise and knowledge claims.[16] STS emerged in the 1960s in response to the growth of science and technology in modern societies and their increased use in public policy.[17] One of the distinguishing features of STS is its departure from conventional positivist accounts of science. STS scholars strongly advocate in favour of the conceptualisation of science as *socially constructed* and, in this crucial aspect, differ from logical positivist accounts of science as 'objective' or

[16] Sophia Roosth & Susan Silbey, 'Science and Technology Studies: From Controversies to Post-Humanist Social Theory,' in Bryan S. Turner (ed), *Blackwell Companion to Social Theory* (Blackwell Publishing, 2nd edn, 2008) 1, 15.
[17] Ibid.

scientific enquiry as geared towards the search for 'truths' about nature. STS challenges positivist-empiricist accounts of science as rational and objective representations of the natural world through its alternative promulgation of a sociological understanding of science as a product of collective social interactions.[18] STS scholars consider science to be constituted by socio-historical processes that are marked by perspectivism, inter-subjective negotiation, and agonistic modes of dispute and contestation. In this regard, the STS conception of science is aligned with the Popperian idea of science as a series of unrefuted hypotheses rather than an accumulation of truths about nature, which is characteristic of scientific orthodoxy.[19] It is even more closely aligned with the Kuhnian idea that science is subject to periodic massive revolutions, whereby an entire paradigm is dismantled and replaced by a new one.[20]

However, STS departs from the philosophy of science in one crucial aspect, namely in its recognition of science as a socially determined and inter-subjectively constituted knowledge system. Roosth and Silbey observe that, "despite diverse theoretical, pragmatic, and disciplinary sources," and arguably different epistemologies, "science and technology studies seemed to force an orienting consensus that science is a *social institution*."[21] Prominent STS scholars like Sheila Jasanoff have deemed social constructivism to be an attitude, mindset, or "belief that the categories we think in, and with which we organise the world, are *social* achievements," accompanied by a methodological orientation towards interrogating knowledge claims.[22] This includes

[18] See Roosth & Silbey for a discussion of Mannheim's sociological critique of Robert Merton's empiricist-positivist account of science and Ludwig Fleck's critique of Viennese logical positivism through his theorisation of the social production of scientific facts through a "thought collective." S.Roosth & S.Silbey, n16, 2-3.
[19] See K.Popper, n1, 23.
[20] See T.Kuhn, n4, 4.
[21] Ibid.
[22] S.Jasanoff, n1, 265.

making determinations about how universally accepted scientific propositions got to be that way.[23] Thus, a sociological-constructivist conception of science and knowledge production constitutes a unifying epistemological thread that runs through most STS scholarship.

For several decades, constructivism has been a popular epistemological framework used by social scientists in their studies of science and technology. The constructivist position that "social forces constitute not only the context, but the content of science"[24] has sociological and anthropological roots. The preoccupation of much STS scholarship since the 1960s and 1970s has been with "questions of material practices that embody the work of doing science."[25] The constructivist epistemology was popularised by the third wave of STS scholarship.[26] The universal positivist view of science as a purveyor of rational and objective truths was subsequently challenged and gave way to new demands for science to be better attuned to and legitimated by local interests and values.[27]

Among the most compelling constructivist studies of science are those undertaken by STS scholars. Leading STS scholars like Bruno Latour contend that the idea of science and politics as discrete epistemic spheres is dated and out-of-sync with the conditions of postmodern societies where the dichotomies of nature/society, facts/values, and

[23] Ibid.
[24] S.Roosth & S.Silbey, n16, 7.
[25] Ibid, 8.
[26] Collins, H.M. and Evans, R. (2002) 'The Third Wave of Science Studies: Studies of Expertise and Experience' (2002) 32 *Social Studies of Science* 2. The third wave of STS refers to the sociology of science, a research program largely driven by the Edinburgh and Paris Schools during the Cold War and decolonisation. The leading authors of Actor Network Theory (ANT), Bruno Latour and Michel Callon, belong to the Paris School.
[27] Steve Fuller, *New Frontiers in Science and Technology Studies* (Polity Press 2007) 2.

science/politics do not hold.[28] While consensus is generally believed to be the pre-requisite for 'core' or established scientific knowledge, constructivists argue that regulatory science or 'science for policy' will always constitute *interpretation* of a knowledge base, since the nature of science implies a certain degree of indeterminacy.[29] The strand of social constructivism that is prevalent in much STS scholarship was popularised by Latour and his colleague Woolgar in the 1980s through their dissolution of the distinction between nature and culture in their seminal work, *Laboratory Life: The Construction of Scientific Facts*. Latour and Woolgar posit that constructivism spans the divide between nature and culture and emphasise the inadequacy of social explanations for the agency of non-human entities which have a prominent role in scientific practices.[30] Through these notable epistemic moves, the STS brand of constructivism assumed significance for its reconceptualisation of science as thoroughly 'encultured and politicized.'[31]

In addition, STS scholarship emphasises the idea of scientists as social beings whose work comprises forms of social practice that take place within larger assemblages,[32] networks,[33] or 'epistemic communities.'[34] As social beings, scientists possess a particular disciplinary orientation which is constituted by their training and the value-laden selection of their objects of study and theoretical frameworks. Scientists'

[28] Bruno Latour, *Pandora's Hope: Essays into the reality of science studies* (Harvard University Press 2013) 6; Larry S. Luton, 'Climate Scientists and the Intergovernmental Panel on Climate Change: Evolving Dynamics of a Belief in Political Neutrality' (2015) 37 *Administrative Theory & Praxis*, 149.
[29] T.Skodvin, n5, 10.
[30] Michael Lynch, 'Social Constructivism in Science and Technology Studies' (2016) 39 *Human Studies* 101, 107.
[31] Ibid.
[32] See Gilles Deleuze & Felix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia* (University of Minnesota Press 1987).
[33] See Bruno Latour, *Science in Action* (Harvard University Press 1987).
[34] See Peter M. Haas, 'Introduction: epistemic communities and international policy coordination' (1992) 46 *International Organization* 1.

experience or study of natural phenomena is therefore heavily mediated by such choices. As STS scholar Daniel Lee Kleinman pertinently observes:

> Scientists' training affects where they look, how they look at phenomena they study, and consequently what they see…the content of [their] training is thoroughly social. It is developed in educational systems through the interaction of certified scientists. It develops and varies over time and place…Scientists are exposed to theories during their training, and again, these shape where scientists look, how they view what they see, and what they see…The categories, orientations, and at some level the values on which scientists draw are affected by their disciplinary orientation.[35]

The image of scientists that Kleinman presents is characteristic of an STS-constructivist understanding of science not only as a product of social interactions, but also as a field of social practice that possesses its own culture(s). This more textured understanding of science as both a social and cultural construct permeates ethnographic STS studies of laboratory practices, processes of scientific discovery and technological innovation. Borrowing traditional methodological tools from anthropology and sociology, namely ethnography, STS laboratory studies also developed its own hybrid methodologies by drawing upon critical theory, ethnomethodology, and symbolic interaction "to pay close attention to the cumulative consequences of micro-transactions, discursive strategies, and forms of representation within the production of a particular scientific fact or practice."[36] Some STS scholars have also made a persuasive case for recognising the work of scientists as "fundamentally and thoroughly political" in the sense that the political and social are inextricably linked.[37] Kleinman contends that, in so far as

[35] D.L. Kleinman, n6, 6.
[36] S.Roosth & S.Silbey, n16, 10.
[37] D.L. Kleinman, n6, 10.

scientists make particular selections informed by value judgments, the practice of science and technology remains infused by power as both an enabling and constraining force, making possible the realisation of certain goals by some scientists (e.g. a senior scientist or science professor) and not others (e.g. a junior scientist or student).[38] Such power asymmetries are visible on a discursive terrain, with dominant scientific discourses prescribing the criteria for legitimacy based on their superior command of cultural and economic resources.

STS research also challenges the positivist notion of science as a uniquely bounded and autonomous discipline (referred to as the 'demarcation problem'[39]), instead arguing that scientific 'facts' or findings cannot be divorced from the wider social context in which they are produced. More specifically, much contemporary scientific work takes place at the boundaries of 'science' and 'non-science' (e.g. policy or law). Accordingly, the concept of 'boundary work' developed by Thomas Gieryn[40] is also a central preoccupation of STS scholarship. Such studies examine the human interactions that shape scientific facts and the membership of scientific communities, including those between scientists and non-scientists in trans-scientific knowledge production processes. The central preoccupation of contemporary STS scholarship is the examination of trans-scientific knowledge production that occurs at the boundary or interstices of science and policy, particularly in regulatory scientific institutions, of which the IPCC is a salient example.

[38] Ibid, 12-13.
[39] The 'demarcation problem' refers to the challenge for science in distinguishing itself as an autonomous and authoritative discipline against its rivals (non-science or pseudo-science). Increasingly it also refers to the challenge for science to justify its special autonomous status in light of demands for democratic inclusion and legitimacy or accountability by lay publics. Much STS scholarship rejects science's demarcation problem. S.Fuller, n27, 4-5.
[40] Thomas F. Gieryn, 'Boundary Work and the Demarcation of Science and Non-science: Strain and Interests in Professional Ideologies of Scientists' (1983) 48 *American Sociological Review* 6.

Climate change is an issue which has prompted a significant revision among STS scholars of the goals of STS in contemporary society. It has also reoriented the field towards questions relating to the democratic implications of the increasing complexity and inaccessibility of scientific and expert knowledge and our collective survival.[41] However, constructivist analytic methods furnished by STS have proven to be double-edged in relation to climate change. More specifically, STS scholars have expressed concern about the misappropriation of their constructivist tools by climate skeptics and denialists to attack and deconstruct mainstream climate science.[42] In relation to climate science and the IPCC consensus, the repudiation of the demarcation problem by some STS accounts might prove to be a deconstructionist bridge too far. Steve Fuller argues that the demarcation problem merits revival today, as there is a need for a "non-providential" account of the nature of science.[43] He therefore characterises the rejection of the demarcation problem as "an overreaction that has thrown out the teleological baby with the bath water in making sense of the history of science."[44] While recognising its latent methodological dangers, particularly the potential for the deconstruction of climate science by deniers as discussed above, I adopt an STS approach on the basis that it offers valuable tools for the study of scientific practice and knowledge production and remains "integral to the normative re-orientation of science and technology that is taking place in our so-called postmodern times."[45] More specifically, the STS-constructivist postulate that science is socially constructed and scientific communities carry their own

41 S.Roosth & S.Silbey, n16, 15.
42 Ibid; See Bruno Latour, 'Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern' (2004) 30 *Critical Inquiry* 225.
43 S.Fuller, n27, 12.
44 Ibid.
45 Ibid, 4.

forms of cultural and political baggage, renders intelligible the knowledge practices within regulatory scientific institutions like the IPCC which exemplify boundary work.

III. Prominent STS-Constructivist Methodologies

Actor Network Theory

This section assesses the suitability of Latourian constructivist methodology in relation to a study of climate change knowledge production, particularly the construction and framing of climate science and the IPCC consensus. To that end, the following sub-sections examine a key component of Latour's constructivist methodology, namely Actor Network Theory (ANT), in terms of its potential applications for and relevance to climate science and this thesis.

i. Applying Actor Network Theory to Climate Science?

As one of the most reputed STS-constructivist analytic methods for the study of science and technology or 'technoscience,'[46] Bruno Latour, Michel Callon and John Law's 'Actor Network Theory' (ANT) merits serious consideration as a conceptual framework that can be potentially applied to examine scientific practice and knowledge production processes pertaining to climate change. ANT can be read as a 'pan-constructivist ontology'[47] of knowledge production that radically departs from metaphysical and logical positivist modes of epistemic enquiry, namely a genealogical search for the

[46] Sergio Sismondo, *An Introduction to Science and Technology Studies* (Blackwell Publishing 2004) 81.
[47] M. Lynch, n30, 108. It is not clear what the 'pan' in 'pan-constructivist ontology' stands for. Michael Lynch might be alluding here to Latour's discussion of the three key features of scientific networks – mobility, stability, and combinability – which render 'domination at a distance' feasible. On this point, Latour asserts that "the results of building, extending and keeping up these networks is to *act at a distance*, that is to do things in the centres that sometimes make it possible to dominate spatially as well as chronologically the periphery." See B.Latour, n32, 223.

origins of scientific facts or 'truths' about nature. Rather, it is a *relational materialist* theory which transforms the 'social' to the material both inside and outside of science.[48] That is, science and technology work by translating material actions and forces from one to the other.[49] Latour is a leading exponent of the idea that scientific practice or 'science in the making' (context) and scientific content are constituted through *networks*.

Eschewing purely social explanations of scientific practice,[50] Latour argues that analytic attention should instead be directed to expanded domains of action and agency encompassing the human, but also extending beyond it to the non-human.[51] This means paying attention to not only humans, but equally to non-human entities such as laboratories, lab equipment, collective agencies, and theoretical causes, that feature as subjects within an enlarged field of action and narratives about scientific discovery and technological innovation. All these entities, whether human or non-human, possess and exercise agency as actors or 'actants.'[52] ANT theorists maintain that the process of constructing scientific facts and transforming them into 'black boxes' is a *collective process* that involves cumulatively garnering support from networks made up of human and non-human actants interacting with one another and exercising agency. A knowledge claim undergoes several rounds of translation, in turn modified by each actant within the network that makes an interpretive contribution.

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[48] Bruno Latour, n33; John Law, 'After Ant: Complexity, Naming and Topology' (1999) 47 *The Sociological Review* 1; S.Sismondo, n46, 82.
[49] S.Sismondo, n46, 82.
[50] Explanation here means a classically privileged form of representation dominant in Western science since the heyday of Newtonian mechanics, namely one that "unifies by reducing, that explains most phenomena by the fewest principles and…implies a radical asymmetry whereby one representative (the explainer) stands for as many representables (the explained)." S.Fuller, n27, 98-99.
[51] B.Latour, n33, 221.
[52] Ibid.

ANT constitutes part of the broader epistemological shift towards post-humanism in the humanities and social sciences, particularly through its promulgation of ideas about non-human agency. Consequently, it is not without controversy and has been the target of extensive criticism by many sociologists and anthropologists. A common critique of ANT is that it is ill-attuned to differences between human and non-human agency and is depoliticised to the point of being complicit in the reinforcement of neoliberal hegemony in academia and society at large.[53] In the 1990s, the Latourian brand of constructivism embodied by ANT came under fire from natural and social scientists alike – a period that became known by the moniker "science wars." Much of the controversy surrounding constructivism in the 1990s was marked by misunderstandings about what was meant by 'construction.' The scientific establishment equated the concept with a generalised deconstructionist attitude of skepticism in relation to scientific findings.[54]

However, contemporary STS scholars are equally wary of the potential for their methods of enquiry to be subverted and replaced by radical forms of deconstructionism, which may be used to advance suspect ideological agendas such as climate denialism. This accounts for why, in more recent work, Latour has defended his brand of constructivism as a pathway towards the renewal of empiricism. For example, he asserts that, "the point was never to get *away* from facts but closer to them, not fighting empiricism, but on the contrary renewing it."[55] In a similar vein, STS-ANT theorists, John Law and John Urry, observe the following:

[53] Andrew B. Kipnis, 'Agency between humanism and posthumanism: Latour and his opponents' (2005) 5 *HAU: Journal of Ethnographic Theory* 2, 44.
[54] M.Lynch, n30, 109.
[55] B.Latour, n33, 231.

> [Research methods] enact realities; they can help to bring into being what they also discover…There is little difference between physics and social science [in that] theories and methods are protocols for modes of questioning or interacting, which also produces realities as they interact with other kinds of interactions. This means we are not saying that reality is *arbitrary*. The argument is not relativist nor realist. Instead it is that *the real is produced in thoroughly non-arbitrary ways, in dense and extended sets of relations*. It is produced with considerable effort, and it is much easier to produce some realities than others. In sum, we are saying that *the world we know is both real and it is produced* [emphases mine].[56]

Accordingly, ANT can be read not only as an analytical framework for understanding knowledge production, but also as an epistemological imprimatur for the pursuit of a more critical mode of enquiry, namely a networked and relational understanding of climate science, its knowledge claims, and its controversies. Through these *post hoc* caveats, Latour and his contemporaries seek to draw an important conceptual distinction (and indeed create necessary conceptual distance) between ANT-style constructivist analyses and deconstructionism. Latour's anxieties about the latter are particularly pronounced in relation to climate change, which he regards as a domain that is now beyond scientific contestation.[57]

ii. Potential applications for this thesis

ANT enables the conceptualisation of both human and non-human entities such as *inter alia* climate scientists, the IPCC and its processes, states, climate law and policy regimes (i.e. the UNFCCC and its processes), courts, harmed or vulnerable individuals and

[56] John Law & John Urry, 'Enacting the Social' (2003) 33 *Economy and Society* 3, 3.
[57] Ava Kofman, 'Bruno Latour, the Post-truth Philosopher, Mounts a Defense of Science' *New York Times* (25 October 2018) <https://www.nytimes.com/2018/10/25/magazine/bruno-latour-post-truth-philosopher-science.html> accessed 25 October 2018.

groups (i.e. litigants or claimants), governments and fossil fuel corporations (i.e. defendants), climate denialists, and the environment as key actors in the transnational climate change network. In other words, knowledge production processes and epistemic controversies surrounding climate change, whether in the IPCC or in climate litigation within domestic courts, can be better understood as a complex set of networked relations comprising all these entities. These networked relations are in turn characterised by both episodes of consensus formation on the one hand (e.g. IPCC processes and climate litigation) and agonistic dispute, controversy, resistance, and dissensus on the other (e.g. climate denialism and again climate litigation). Latour instructs us to turn our attention to such episodes and to "follow the tortuous history" of scientific statements to determine how established bodies of knowledge like climate science became scientific 'facts'.[58] These sites and episodes of knowledge and consensus-making and contestation in transnational climate change governance constitute the core analytic focus and subject matter of my research.

An STS mode of analysis, particularly ANT, provides one potentially useful pathway towards fruitful analytic engagement with the complexity of climate change knowledge politics and for understanding its broad ranging implications for law and policy. Therefore, in this PhD project, I use ANT to study not only the production of climate science within the IPCC, but also its treatment within transnational judicial and NGO-litigant networks at various sites including UNFCCC COPs, judicial conferences, and domestic courts. My PhD project is predicated on Latour's fluid conception of the network as "a metaphor of connections," which dissolves scale related distinctions of

[58] B.Latour, n33, 103.

micro and macro or top down systems of ordering.[59] The advantage of employing this definition of network is that it "allows us to think of a global entity – a highly connected one – [as] nevertheless continuously local."[60] It also dismantles the distinction between inside and outside, and instead privileges the idea that "a network is always a boundary without any inside or outside."[61]

More recently, Latour has reframed and updated ANT in line with German philosopher Peter Sloterdijk's work on 'spherology,' emphasising the similarities and complementarities between his idea of networks and the latter's concept of 'spheres,' which connotes hybrid realities and spaces of co-existence.[62] In this regard, Latour observes the following:

> While networks are good at describing long-distance and unexpected connections starting from local points, spheres are useful for describing local, fragile, and complex atmospheric conditions. Networks are good at stressing edges and movements; spheres at highlighting envelopes and wombs.[63]

Both Latour and Sloterdijk also reject dualisms such as nature versus culture, nature versus man, and subject versus object. Considered in the context of climate change, such dichotomies have proven to be problematic and divisive. Sloterdijk's spherology complements ANT scholars' ideas about connectedness through transnational networks.

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[59] B.Latour, n33, 5.
[60] Ibid.
[61] Ibid.
[62] Peter Sloterdijk, 'How big is big?' (2010) <http://www.collegium-international.org/index.php/en/contributions/127-how-big-is-big> accessed 10 August 2017; Martin Skrydstrup, 'Of spheres and squares: Can Sloterdijk help us rethink the architecture of climate science?' (2016) 46 *Social Studies of Science* 6, 854.
[63] Bruno Latour, 'Some experiments in art and politics' (2011) *E-flux Journal* 23, 471-490.

For example, in a recent essay on climate change, Sloterdijk takes up Buckminster Fuller's concept of 'Spaceship Earth' - a shared ecological space and macro-interior where the goal is atmospheric stabilisation.[64] He further posits that meteorology (i.e. Earth System Science) has come to power precisely because its central project of atmospheric mapping spans the entire Earth as one contiguous space:

> [Meteorology] has become politically and scientifically accepted because for the moment it offers the most suggestive model of the global interior: it deals with the dynamic continuum of the terrestrial sheath of gas that envelopes the Earth and which since the days of the Greek physicists we have called the atmosphere, which meant "ball of vapour."[65]

Therefore, a good way to understand 'climate' is through this alternative conceptualisation or mapping of space, whereby Earth can be thought of as a 'supra-sphere' made up of networks.[66] The sites of scientific knowledge production on climate change therefore exist and operate in this supra-sphere. More specifically, these fluid conceptions of network and 'sphere' aptly capture the hybrid and complex dynamics of contemporary climate change governance and regulation as well as environmental regulation writ large, which are being predominantly carried out at numerous sites in the liminal space between the global and local through dense transnational networks comprising a plethora of entities. These include hybrid regulatory actors like the IPCC, which operate at the intersection or boundaries of science, law, and policy.

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[64] Peter Sloterdijk, n62.

[65] Ibid.

[66] In addition to space, time and scale are also integral to the conceptualisation of 'climate.' Another related mapping project by geologists (The Royal Society of Stratigraphers and its Anthropocene Working Group) and historians has been to conceptualise the anthropogenic carbonisation of the Earth and the resulting climate crisis in terms of a new geological epoch – i.e. the Anthropocene – a term popularised by the atmospheric chemist Paul Krutzen. See Will Steffen, Paul J. Krutzen, & John R. McNeill, 'The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?' (2007) 36 *Ambio* 8.

Furthermore, ANT enables us to understand the IPCC as a metropolitan site of climate change knowledge production and IPCC knowledge work as the continuous "build[ing], exten[ding], and keep[ing] up of scientific networks by acting at a distance" to maintain spatial and chronological epistemic dominance at the periphery.[67] In sum, ANT and Latour's fluid relational conception of network are coterminous with the idea of networked governance, which is already a familiar trope in transnational environmental law and policy.[68] More importantly, constructivist modes of enquiry, such as ANT and ethnographic studies of science (e.g. STS lab studies), are invaluable methodological tools that can serve to demystify the workings of science and render them more intelligible to non-scientists and lay publics. Throughout this PhD project, I apply Latour's fluid relational conception of the network to map all the knowledge-based activities undertaken by dense epistemic networks of climate scientists (i.e the IPCC in Chapter Three), domestic courts (Chapters Four and Five) and ENGO litigants (Chapter Six).

Jasanoff and the 'Co-production Idiom'

STS also provides pertinent analytic frameworks for the study of 'uneven processes' through which scientific and technical knowledge are produced and become entangled with projects of norm creation and social and political ordering.[69] Jasanoff and her STS

[67] B.Latour, n33, 232.
[68] Daniel L. Feldman, 'The future of environmental networks – Governance and civil society in a global context,' *Futures* (7 July 2012) < http://dx.doi.org/10.1016/j.futures.2012.07.007 > accessed 29 November 2016. Feldman contends the while knowledge networks already exist, they have the potential to become the primary means of global environmental governance because they can decisively act to: assess information and data, evaluate innovative management options, and coordinate the activities of key actors at local and regional levels without having to wait upon national governments and intergovernmental organizations to act.
[69] Sheila Jasanoff, *States of Knowledge: The Co-production of Science and Social Order* (Routledge 2004) 2.

colleagues posit that in "broad areas of both past and present human activity, we gain explanatory power by thinking of natural and social orders as being co-produced."[70] They accordingly conceptualise co-production as "a shorthand for the proposition that the ways in which we know or represent the world (both nature and society) are inseparable from the ways in which we choose to live in it."[71] Finally, they also advocate for a more nuanced understanding of the term as an 'idiom' – "a way of interpreting and accounting for complex phenomena so as to avoid the strategic deletions and omissions of most other approaches in the social sciences."[72] Most STS analyses situated in this vein examine how knowledge production is incorporated into practices of state-making or governance and, conversely, how governance processes in turn influence knowledge production and use.[73]

Clark Miller notes that the co-production idiom is highly valuable "[as] it enables the observer to become attuned to the multiple ways that knowledge and order become coupled in the emergence of a new phenomenon like climate change."[74] The concept is therefore seminal to this research project and employed throughout to make sense of the nexus between science and law (the various epistemic processes and interactions between key actors) and its formative role in new projects of transnational legal ordering in response to climate change. Subsequent chapters document how climate science is being co-produced by climate scientists, courts and climate litigants, at multiple sites including the IPCC and domestic courts.

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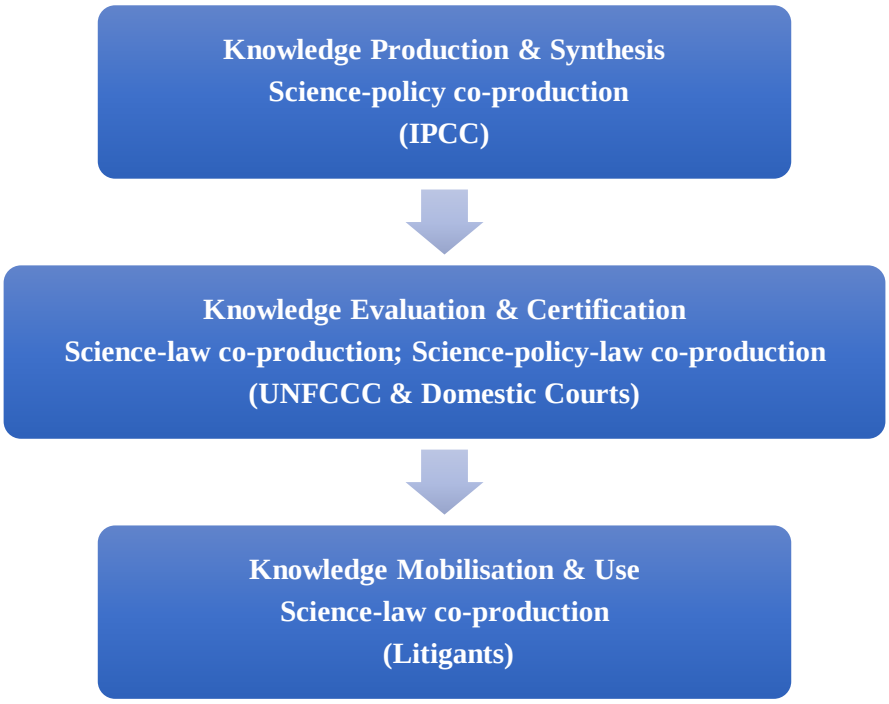
70 S.Jasanoff, n69, 2.
71 Ibid.
72 Ibid, 3.
73 Ibid.
74 Clark A. Miller, 'Climate science and the making of a global political order,' in S.Jasanoff (ed), n69, 61.

Fig 2. Transdisciplinary Co-production of Climate Science



These processes are constitutive of a new kind of climate politics ushered in by the IPCC and UNFCCC regime, and subsequently carried forward by global civil society in recent years. Subsequent chapters also argue that this new climate politics, as embodied by growing waves of science-driven and evidence-based climate litigation and adjudication, is in turn co-producing a new transnational legal commons on climate change.

The Science-Law Interface

Science for action can be considered another major epistemic movement or school of enquiry within STS scholarship that is mainly concerned with the ways in which science is used in public policy and legal settings. Put another way, the principal object of study is law-science interactions and the ways in which such interactions are geared towards

informational improvement in knowledge societies, the facilitation and improvement of public decision-making and contributing to "the central project of governance in modern democracies."[75] Jasanoff emphasises that the more pertinent constructivist enquiry is not how 'good' the science is, but rather how much deference scientific expertise deserves in specific legal contexts.[76] Therefore, science for action is concerned not with the processes of fact finding *per se*, but with its purposes or ends – something Jasanoff refers to as "serviceable truth."[77] This connotes a form of normative pragmatism where the primary demand is not for scientific objectivity or 'truth' for its own sake. Rather the important question to ask is how science can best aid and advance the purposes of law (e.g. to produce a fair and just outcome.)[78]

This branch of STS scholarship also posits that the cultures of law and science are mutually constitutive. Both are domains of expertise which interact and collaborate to co-produce society at large.[79] The scientific community and courts occupy central positions in this co-production narrative. In spheres of activity that are heavily governed by regulatory science such as, *inter alia*, bioethics, human health, and the environment, adjudication and litigation have become important mechanisms for vetting and validating science and technology. These legal processes serve to deconstruct science and flag ethical concerns in relation to its use in public policy.[80]

[75] Sheila Jasanoff, 'Serviceable Truths: Science For Action in Law and Policy' (2015) 93 *Texas Law Review* 1723, 1724.
[76] Ibid.
[77] Ibid, 1725.
[78] Ibid, 1730.
[79] Sheila Jasanoff, *Science at the Bar* (Harvard University Press 1998) 8.
[80] Ibid.

'Science for action' enquiries can further our understanding of how the law interprets, implements, and legitimates science. US Supreme Court justice Stephen Breyer suggests one potential pathway towards effective collaboration between law and science, with an emphasis on how the former can facilitate the scientific enterprise:

> The practice of sound science depends on sound law – law that at a minimum supports science by offering the scientist breathing space, within which he or she may search freely for the truth on which all knowledge depends…we must search for a law that reflects an understanding of the relevant underlying science, not for law that frees companies to cause serious harm or forces them unnecessarily to abandon the thousands of artificial substances on which modern life depends."[81]

Reflecting on the role of law in terms of its responsible use and representation of science, Breyer further opines that it is not for the law (including courts and judges) to aim for scientific precision, but rather to "seek decisions that fall within the boundaries of scientifically sound knowledge and *approximately reflect* the scientific state of the art."[82]

Science for action analyses can also help us understand the processes through which science is translated into policy and law and to map the ways in which actors deploy science as 'serviceable truth' in legal proceedings to advance their claims.[83] The use of science as serviceable truth or, alternatively, as an epistemic aid for legal claims is borne out in climate litigation contexts. For example, in the Dutch *Urgenda* case, the plaintiffs

[81] Stephen Breyer, 'The Interdependence of Science and Law' (1998) 280 *Science* 5363, 537.
[82] Ibid.
[83] S.Jasanoff, n75, 1730.

relied heavily on IPCC climate science to successfully argue before the Hague District Court that the Dutch government had breached its duty of care towards its citizens by failing to adopt a policy designed to reduce Dutch emissions by 25 to 40% below 1990 levels by 2020 – the target required to prevent dangerous interference with the climate system (i.e. warming of less than or up to 2 degrees Celsius above pre-industrial levels).[84] In its own assessment of the substantive issues, the Hague District Court also made considerable use of IPCC assessments and arrived at a number of conclusions based on IPCC climate science. The Court's key ruling stated that the Netherlands was obliged to reduce emissions by 25 to 40% below 1990 levels by 2020 and 80% by 2050 "in line with the IPCC's proposed reduction target for a 450 scenario by 2050."[85] The *Urgenda* case is a prominent recent example of a climate change case in which the judiciary exhibited a high degree of deference towards IPCC climate science. It also demonstrates how courts function as key intermediaries and gatekeepers in the societal validation and dissemination of technoscientific knowledge – an issue explored in further detail in Chapters Four and Five.

Jasanoff observes that a high degree of deference should be exercised where a consensus exists and attempts to deconstruct consensus may appear wasteful and illegitimate.[86] However, she argues that while "the existence of a strong scientific consensus may dilute the need to scrutinise scientific claims, it is not an invitation for the law to abdicate its normative responsibilities," particularly in terms of rendering exercises of scientific-

[84] Roger Cox, 'A Climate Change Litigation Precedent: Urgenda Foundation v The State of the Netherlands' (2015) CIGI Papers, No.79 < https://www.cigionline.org/publications/climate-change-litigation-precedent-urgenda-foundation-v-state-netherlands> accessed 5 July 2017, 12; *Stichting Urgenda* v *Government of the Netherlands* (Ministry of Infrastructure and the Environment) ECLI:NL:RBDHA:2015:7145, Rechtbank Den Haag, C/09/456689/HA ZA 13-1396.
[85] *Urgenda*, Ibid.
[86] S.Jasanoff, n75, 1742.

epistemic authority accountable.[87] In so far as scientific work entails socio-political choices, for example, in terms of the selection of individuals or bodies to carry out work for particular ends, science is not apolitical, but is rather a sphere of activity subject to accountability requirements. These accountability considerations appear valid and applicable in relation to the work of boundary organisations like the IPCC which produce scientific knowledge for policymaking (as discussed in Chapter Three). Moreover, the concentration of epistemic power in the IPCC in relation to climate change has generated legitimate concerns about accountability. Sismondo notes that since STS makes no separation between epistemic and political processes, it can genuinely study scientific and technological societies, rather than treating science and technology as political externalities.[88] In this regard, STS scholarship closely examines "political economies of knowledge: the production, distribution, and consumption of knowledge."[89] STS modes of analysis (such as ANT and science for action) therefore enable a holistic examination of the knowledge politics of climate change, which I argue encompasses not just the production and synthesis of climate science within the IPCC, but also the certification and use of climate science by domestic courts and climate litigants, respectively.

IV. The STS Critique of Climate Science

Building on her earlier proposition that the existence of a scientific consensus does not obviate the need to closely scrutinise scientific practice and engage in ongoing critical reflection, Jasanoff has offered a compelling critique of climate science and the knowledge work of the IPCC. In earlier work, she has articulated a commonly held STS-

[87] S.Jasanoff, n75, 1742.
[88] S.Sismondo, n46, 189.
[89] Ibid.

constructivist perspective on science, noting that it is always conditioned by the specific social and cultural contexts in which it is produced. She accordingly argues that the very image of science in any given society reflects the features of social organisation and preference that are *not universal* and it is in this sense that science as an institution is socially constructed.[90] In other words, it is also always a locally inflected knowledge enterprise.

In more recent work, she expands upon this point to argue that our collective future is at stake "when an impersonal, apolitical, and universal imaginary of climate change, projected and endorsed by science, takes over from the subjective, situated and normative imaginations of human actors engaging directly with nature."[91] She emphasises the need to connect scientific knowledge-making on climate change at the global level to processes of meaning-making that are more locally situated.[92] In addition, she advocates a role for "the interpretive social sciences in fostering a more complex understanding of humanity's climate predicament."[93] Jasanoff's critique here is directed at climate science and the knowledge practices of the IPCC, which she perceives as decontextualised and delocalised, describing its scientific work as detached observation devoid of meaning, which can be found in the embedded experiences of local communities.[94] This reflects her underlying concern about the inability of global governance institutions to better engage with and respond to the needs of local publics that are affected by their decisions. In short, there is an academic-constructivist anxiety here about the absence of participatory inclusiveness, political contestation, and

90 S.Jasanoff, n9, 271.
91 Ibid, 235.
92 Ibid.
93 Ibid.
94 Ibid.

democratic decision-making. This position also reflects a deeper ideological commitment to challenging the pernicious neoliberal capitalist logics and agendas (i.e. the industrial and technoscientific revolutions) responsible for creating the climate change problem in the first place. On this view, the existing reliance on markets and technology as panaceas to climate change is anathema to the idea that any meaningful resolution demands systemic and structural upheaval, namely through the disavowal of neoliberal capitalism and its environmentally destructive tendencies. This has led many social scientists and humanists to advocate for the inclusion of alternative (i.e. non-economic and non-scientific) epistemologies of climate change into existing decision-making frameworks.

Jasanoff's concerns about the IPCC have also been echoed by other social scientists and humanities scholars. Recent STS scholarship makes the claim that the dominant technoscientific narrative of climate change occludes other locally specific ways of knowing about climate change, obstructs more just outcomes, and thereby results in 'slow violence.'[95] Put another way, a major charge against the IPCC by STS-constructivist scholarship is that the dominance of the physical sciences within its knowledge practices also erases human subjectivities and excludes potentially significant local bodies of knowledge (particularly from the Global South) and alternative framings and disciplinary narratives of climate change. Colombian geographer and feminist scholar Astrid Ulloa asserts that the epistemological perspectives of indigenous peoples in Latin America with respect to climate change are

[95] S.Jasanoff, n9, 235; 'Slow violence' is a term recently popularised by Rob Nixon to connote the latent, gradual, and negative externalities related to the abuse of environmental resources and ecosystems. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Harvard University Press, 2011); Shannon O'Lear, 'Climate Science and Slow Violence: A view from political geography and STS on mobilizing technoscientific ontologies of climate change' (2016) 52 *Political Geography* 4.

ignored by the existing scientific and policymaking paradigm.[96] She argues that Northern climate change policies and programs (such as UN REDD+) naturalise particular gender relations and exacerbate inequalities and exclusions, "[resulting] in a kind of blockage of alternative ways of producing knowledge about climate change."[97] Political geographer Shannon O'Lear similarly argues that climate science, particularly the IPCC's account, is mobilised in ways that enact 'slow violence,' by making an indirect and latent contribution to human suffering.[98] Directly inspired by Jasanoff's work, she explicitly adopts an STS-constructivist perspective to contend that the IPCC's reliance on global circulation models (GCMs) and carbon data forecloses alternative ways of knowing about climate change.[99] At the core of these critiques is the notion that by purporting to act and speak on behalf of the entire world (as a purveyor of universal 'truths' or facts about climate change), the IPCC embodies and enforces a form of epistemic hegemony or neocolonialism. In doing so, it operates in a technocratic space devoid of genuine deliberation and richer forms of politics. These scholars accordingly argue in favour of 'repoliticising' or developing a new kind of politics of climate change.[100]

Such criticism may be partially warranted in relation to the IPCC's scientific work as carried out by Working Group I (WGI). WGI's assessment and review procedures are indeed dominated by a positivistic natural science paradigm (standing in as the universal *episteme*[101]) and, by implication, exclude alternative epistemologies as well as local and

[96] Astrid Ulloa, 'The Geopolitics of Carbonized Nature and the Zero Carbon Citizen' (2017) 116 *South Atlantic Quarterly* 1, 111-112.
[97] Ibid.
[98] S.O'Lear, n95, 4.
[99] Ibid.
[100] Ibid; Geographer Eric Swyngedouw calls it a 'non-political politics.' Eric Swyngedouw, 'The non-political politics of climate change' (2013) 12 *ACME* 1.
[101] Michel Foucault, *The Order of Things* (Routledge 1970, 2002).

indigenous bodies of knowledge. Its membership is almost exclusively made up of scientists who are mostly from Northern countries, meaning that it falls short of being geographically representative. Quantitative studies have also shown that work from particular scientific fields, such as the physical sciences (including the earth sciences such as meteorology and oceanography) dominate WGI's peer review process.[102] In addition, the IPCC's outputs may not gain political acceptance and approval within all societies (particularly some developing countries) due to perceptions of Northern epistemic dominance and bias.[103]

However, on closer inspection, the IPCC's gaze is both global and local; a unique trait that actually distinguishes the institution from its global governance counterparts. It concurrently engages in 'detached scientific observation' and is also increasingly paying attention to local contexts and communities, as evidenced by the practices of its other Working Groups (i.e. WGII and WGIII) in which there is greater integration and hybridisation between the natural and social sciences.[104] The climate science community has acknowledged the importance and value of incorporating local and indigenous perspectives into global knowledge-making processes on climate change. For example, a team of climate scientists from the University of British Columbia recently conducted a study, collecting over 90,000 observations about climate change from indigenous people around the world. The study established that many of these observations are largely consistent with the findings of global climate models.[105] It also emphasised that

[102] Andreas Bjurström & Merritt Polk, 'Physical and economic bias in climate change research: a scientometric study of the IPCC Third Assessment Report' (2011) 108 *Climatic Change* 1, 8.
[103] T.Meyer, n97, 21.
[104] Ibid, 11.
[105] Ari Phillips, 'What 90,000 indigenous people have to say about climate change' (2 May 2016) <http://fusion.net/story/296749/study-of-global-indigenous-climate-history/?utm_source=facebook&utm_medium=social&utm_campaign=socialshare&utm_content=theme_top> accessed 7 May 2017.

human observations and local knowledge derived from indigenous peoples' daily witnessing of climate change impacts around the world can serve to fill knowledge gaps in relation to "poorly understood but important climate-related phenomena."[106] Another 2011 article by a team of bio-scientists proposes a framework for "enhancing synthesis of indigenous narratives of observed climate change with global assessments [such as those of the IPCC]."[107] Moreover, the study disclaims at the outset the authors' awareness "that any attempt to join scientific and indigenous knowledge systems may reflect the history of power relationships between indigenous groups and non-indigenous groups."[108]

Such studies highlight the limitations of existing STS critiques of the IPCC and also foreground the possibilities for more meaningful linkages between complementary bodies of knowledge in addressing climate change. They also show that climate scientists are cognizant of and well-attuned to knowledge deficit problems with respect to climate change that result, in part, from the exclusion of indigenous and alternative epistemologies and worldviews. They have acknowledged that indigenous narratives are minimally included in global assessments such as those of the IPCC due to the prioritisation of peer reviewed materials.[109] They have also emphasised that indigenous narratives are a rich source of data "based on multigenerational knowledge, which promote an expanded and multidimensional picture of climate change impacts."[110]

106 A.Phillips, n 105.
107 Clarence Alexander et al, 'Linking Indigenous and Scientific Knowledge of Climate Change' (2011) 61 *BioScience* 6, 477.
108 Ibid, 478.
109 C.Alexander et al, n107, 478.
110 Ibid, 483.

In particular, many of these narratives have been found to complement, corroborate and align with scientific observations relating to temperature change and sea ice melt.[111] Linkages between climate scientists and indigenous communities are already long-standing and robust in the Arctic. Since the 1990s, climatologists and anthropologists have routinely collaborated with Arctic indigenous peoples upon whom they heavily rely for detailed knowledge about localised climate change impacts such as sea ice and permafrost melt and changes to animal populations and animal migration patterns.[112] A pertinent example of such a collaboration is the Sea Ice Knowledge and Use (SIKU) Project in which climatologists and anthropologists have sought the assistance of Arctic indigenous people to record observations of changes to sea ice.[113] The STS critique of climate science may therefore need to be tempered and modified due to the emergence and proliferation of these new and innovative modes of epistemic engagement between climate scientists and indigenous peoples who are among the most vulnerable to climate change.

Knowledge pluralism?

The STS critique of climate science is not without merit as it speaks to concerns within contemporary knowledge societies about technocracy and epistemic hegemony. It is a critique directed at the *processes* surrounding the production and framing of climate science, and their domination or monopolisation by the global North, rather than its outputs (i.e. the IPCC consensus). Jasanoff rightly argues that "to cast social construction as an attack on the core values of science fundamentally misses the point

111 C.Alexander et al, n107, 483.
112 Eric Loury, 'What Can Indigenous People Tell Us About Climate Change?' *Sciencemag* (19 February 2012) < http://www.sciencemag.org/news/2012/02/qa-what-can-indigenous-people-tell-us-about-climate-change> accessed 3 August 2017.
113 Ibid.

of constructivist enquiry."[114] Her critique is very much informed by this perspective. In that spirit, the following analysis proceeds on the basis that the core STS-constructivist critique of climate science practices is sound, as it highlights defects in the knowledge production process that may warrant improvement and reform.

However, it is not an exhaustive critique of climate science and IPCC knowledge practices and therefore ought to be regarded with caution for two related reasons. Firstly, it does not account for the potential advantages of reserving a greater or even exclusive role for science in initially defining the climate change problem. Secondly, it elides the dangers of knowledge pluralism in the already highly politicised world of climate change policy. Not all forms of knowledge are equal or persuasive. Admitting local and indigenous bodies of knowledge might not always be desirable as it would risk unleashing a politics of definition mired in endless relativism, which would prove counterproductive. The proposition that local meaning-making processes should be connected to global epistemic processes through which the climate change problem is defined and understood[115] also has retrogressive implications, as it risks unnecessarily repoliticising the now scientifically settled question of whether climate change has anthropogenic roots. It was the excessive politicisation of climate change within its domestic public sphere that prompted the US to propose the creation of a relatively depoliticised independent body such as the IPCC to assume primary responsibility for defining the problem in the first place.

[114] S.Jasanoff, n9, 275.
[115] Ibid, 235.

Depoliticising the space in which climate change is defined, mapped and understood might be desirable for several reasons. Science continues to command significant persuasive power above and beyond many other disciplines. The scientific representation of nature, while neither objective nor 'true,'[116] is nonetheless a relatively persuasive one for many policymakers and many lay-publics. Philosophers of science such as Thomas Kuhn and Karl Popper have observed that the day-to-day work of a scientist or 'normal science,' "presupposes an organised structure of assumptions, or a theory, or a research programme, needed by the community of scientists in order to discuss their work rationally."[117] The authority of science as a discipline (and scientists as an epistemic community) has developed over decades through evolutionary and (less frequently) revolutionary processes, which have engendered a structure of widely accepted scientific doctrines.[118] In addition, science's relative persuasive power derives from the fact that scientific knowledge is usually generated at a remove from political processes[119] (i.e. in relatively depoliticised environments, albeit not without scientists' own political and cultural baggage).

More radical constructivist and STS critiques of science also appear less convincing in light of scientists' own admission that disagreement is a fundamental component of scientific praxis and is crucial to science's paradigmatic evolution and self-improvement.[120] This is consistent with the Popperian view that, since antiquity, science

[116] K.Popper, n1; M.Polanyi, n1, 4.
[117] Karl Popper, 'Normal science and its dangers' in Imre Lakatos & Alan Musgrave (eds), *Criticism and the Growth of Knowledge* (CUP 1965) 51; T.S.Kuhn, n4.
[118] K.Popper, n1, 51.
[119] Peter M. Haas, 'When does power listen to truth? A constructivist approach to the policy process' (2004) 11 *Journal of European Public Policy* 4, 575.
[120] Paul N. Edwards & Stephen H. Schneider, 'Chapter 7: Self-governance and Peer Review in Science for Policy: The Case for the IPCC Second Assessment Report' in Clark A. Miller & Paul N. Edwards (eds), *Changing the Atmosphere: Expert Knowledge and Environmental Governance (Politics, Science, and the Environment* (MIT Press 2001) 10.

has been a critical enterprise characterised by "constant and fruitful discussion between competing dominant theories of matter."[121] While science comes with a canon and particular doctrinal frameworks, these are not immutable. Noting that the 'Myth of the Framework' is the central bulwark of irrationalism in our time, Popper contends that the scientific enterprise is sufficiently reflexive and critical to enable such frameworks to be challenged, broken out of, and remade.[122] He maintains that a critical comparison of scientific theories and frameworks is *always* possible.[123]

Popper's reflections about the nature of science as a critical and fluid enterprise are largely borne out in practice. For example, consensus is only the logical and idealised endpoint of the scientific process, which is largely constituted by iterative cycles of debate and disagreement among scientists. Scientific communities recognise that good science is that which is produced through further investigation and disagreement (i.e. intensive peer review), which results in the filtering out of less persuasive representations of natural phenomena and the expulsion of bias as far as possible.[124] These processes of disagreement, as embodied by peer review, have over time resulted in the creation of a core set of beliefs and principles held by a global scientific-epistemic community.[125]

More specifically, the scientific consensus on anthropogenic climate change represents a breakthrough or paradigm shift whereby the competing views of scientists around a

[121] K.Popper, n1, 55.
[122] Ibid, 56-57.
[123] Ibid 57.
[124] P.N.Edwards & S.H.Schneider, n120, 10.
[125] Ibid; Peter M. Haas, 'Introduction: epistemic communities and international policy coordination' (1992) 46 *International Organization* 1, 3.

particular problem have been reconciled and the fundamentals agreed upon.[126] Climate science has reached a level of maturity whereby it has come to epitomise Kuhn's idea of 'paradigm-as-exemplar.'[127] The same cannot be said of all other bodies of knowledge, including social science disciplines. For example, even economists fundamentally disagree on the optimal way to respond to climate change, as aptly exemplified by the rift between Nicholas Stern and William Nordhaus on the carbon tax issue, particularly the application of discount rates.[128] Jasanoff makes an important concession in this regard, recognising that nature is not endlessly deconstructible, has limited plasticity, and is capable of being meaningfully represented by a few broadly defined camps.[129] These include "epistemic communities united by common perceptions of what counts as natural and what should be done to protect nature [which] do form across divisive social and political lines."[130] Accordingly, scientific expertise may be both appropriate and necessary for shaping our initial understanding of climate change, particularly in the absence of equally viable alternatives. WGI's dominance within and relative independence as an exclusively scientific arm of the IPCC may therefore be preferable. If WGI were to open up and democratise its membership to include non-scientists and other experts, it might risk becoming politicised and subject to capture by interest.

Towards managerialism and technocracy

The verification of climate change as an anthropogenic phenomenon has and continues to occur through a scientific paradigm with Northern roots. It is increasingly difficult to

126 T.S.Kuhn, n4.
127 Ibid.
128 Stern and Nordhaus disagree on the appropriate discount rate to be applied when taking future climate change damage into consideration for the purposes of developing a carbon tax. Nordhaus is skeptical about future discounting. Stern supports the imposition of a higher carbon tax.
129 S.Jasanoff, n9, 245.
130 Ibid.

deny the universal validity of such a paradigm for the reasons discussed above. Nonetheless, the overarching constructivist and STS critique, that a scientific-epistemic hegemony over climate change may have certain undesirable implications, must be seriously considered. Science may be an important tool for the depoliticisation of some of the most crucial areas of contemporary global policy. However, the turn towards a combination of regulatory science, expertise, and managerialism, which underpins our 'world risk society'[131] and global governance, is not without its immanent dangers.

More specifically, the anxieties of STS and critical legal scholars in relation to the ascendance of technocracy are well founded.[132] In many contemporary societies, expert-based regulation and policymaking is increasingly standing in and being substituted for actual democratic politics. The attenuation of the link between policymaking and politics is even greater at the international and transnational levels where non-state actors of all stripes are engaging in regulatory activity.[133] Perez rightly warns that the epistemic monopolies of regulatory scientific institutions like the IPCC may have a destabilising potential, as such institutions can exercise their normative authority to validate their key outputs, thereby short-circuiting the democratic process.[134]

STS therefore serves as a useful analytic framework for the study of hybrid regulatory institutions like the IPCC, as it alerts us to the dangers of knowledge monopolism, managerialism and technocratic governance. Such anxieties were borne out by COP 21

131 Ulrich Beck, 'Living in the world risk society' (2006) 23 *Economy and Society* 3.
132 See Martii Koskenniemi for a critical analysis of managerialism and its role in the reinforcement of hegemonic regimes in public international law, which ties into the broader debates about pluralism and fragmentation in public international law. Martii Koskenniemi, 'Hegemonic Regimes,' in Margaret A. Young (ed), *Regime Interaction in International Law: Facing Fragmentation* (CUP 2012).
133 Benedict Kingsbury, Nico Krisch and Richard B. Stewart, 'The Emergence of Global Administrative Law' (2005) 68 *Law and Contemporary Problems* 357, 15-16.
134 Oren S. Perez, 'The Hybrid Legal-Scientific Dynamic of Transnational Scientific Organisations' (2015) 26 *The European Journal of International Law* 2, 413.

in Paris, which was notable for its marginalisation and exclusion of NGOs and civil society actors from participating in formal climate change negotiations, which occurred largely behind closed doors and were dominated by government officials as well as policymaking and corporate-industrial elites. By contrast, more hardline constructivist perspectives on the IPCC are of limited utility as they do not sufficiently account for the risks associated with liberalising or democratising its knowledge practices to enable input from non-scientific, local and indigenous bodies of knowledge. More specifically, the prescription that epistemic fragmentation and knowledge competition is a desirable antidote to monopolism and compatible with democratic ideals[135] is also not persuasive. Such knowledge competition might have an even greater destabilising potential in terms of engendering an agonistic environment characterised by a new set of power struggles between multiple knowledge providers and subsequently risk the commercialisation of climate change knowledge. The voluntary participation of experts is one of the great virtues of the IPCC assessment cycle and serves to ensure that knowledge production on climate change remains beyond the reach of commercialisation of the kind that currently plagues the global development paradigm.[136] Knowledge pluralism might also risk reversing the fruitful epistemic gains made in relation to climate change over the last two decades.

V. Other Key STS Concepts and their Potential Applications in this Thesis

In addition to employing ANT and co-production as key analytical tools, this section outlines some other major STS concepts that I will rely on to examine climate change

[135] O.S.Perez, n134, 413.
[136] For a further discussion of commercialization of expert knowledge in the development context, see Hans N. Weiler, 'Whose Knowledge Matters? Development and the Politics of Knowledge' in Theodor Hanf, Hans N. Weiler and Helga Dickow (eds), *Entwicklung als Beruf* (Nomos 2009).

knowledge production and its applications in legal settings. These include: i) science for policy (or regulatory science) and; ii) boundary work. These concepts have been selected as methodological tools as they are pertinent for mapping and understanding 'behind-the-scenes' social processes involved in the production and dissemination of scientific knowledge and its incorporation into public policy and law.

i. Science for policy

Contemporary knowledge societies heavily depend on science and other forms of expertise in most spheres of regulatory activity, including the environment. However, the degree of dependence on science and expertise varies across jurisdictions. In the United States, the path to converting science into policy has often been circuitous and fraught, since science is not always automatically considered a *sine qua non* for policymaking. Within US policymaking communities there exists a tendency to discredit science that goes against a particular policy agenda as partisan and politically suspect.[137] Noting that science has become increasingly politicised in the US, Haas argues that "the use of science is mediated and thus possibly distorted by the political goals of potential users."[138] These insights, which reveal the fragile nexus between science and policy, help to partially explain why scientific consensus does not automatically translate into policy in the US.

However, a prominent strand of STS scholarship documents how scientific knowledge is increasingly transformed into a usable core through science-policy interactions that are occurring within international and transnational networks of knowledge-making.

[137] Peter M. Haas, 'When does power listen to truth? A constructivist approach to the policy process' (2011) 11 *Journal of European Public Policy* 4, 572.
[138] Ibid.

STS scholars have variously referred to this usable core of scientific knowledge as 'science for policy,'[139] 'regulatory science'[140] and 'usable knowledge.'[141] These hybrid epistemic-regulatory networks also operate within institutional settings, (e.g. UNEP, UNCED, the IPCC, and MEA treaty bodies like SBSTA (UNFCCC)) as designated providers of policy-relevant or 'usable' scientific and expert knowledge that is intelligible to non-scientific audiences. In Chapter Three, I apply this science for policy lens to study the IPCC, where I extensively document its knowledge work that results in the production of regulatory science in the form of IPCC assessment reports.

These epistemic networks or communities also collaborate with policymakers, government officials, NGOs, IGOs, and civil society actors. Critically, the science generated by these epistemic networks through their work within transnational regulatory institutions, owes its wide uptake and purchase to successful demarcation efforts by their constituent scientific and policy communities.[142] Within these transnational regulatory institutions, including the IPCC, both communities adhere to a social compact whereby mutual respect is afforded to enable each to operate autonomously.[143] Critically, this allows the scientific limb of such organisations to engage in processes of knowledge production and diffusion that are free of political interference, without compromising their own scientific and political legitimacy.[144] In addition, scientific knowledge produced in these settings achieves greater credibility through an added layer of political scrutiny and vetting by governments prior to being

139 Sheila Jasanoff, 'Contested Boundaries in Policy-relevant Science' (1987) 17 *Social Studies of Science* 2, 225.
140 T.Meyer, n97, 21.
141 P.M.Haas, n137, 573-574.
142 T.Meyer, n97, 17.
143 Ibid.
144 P.M.Haas, n137, 576.

incorporated into policy.[145] Despite these prescriptions for producing usable and credible information, scientists retain sufficient latitude within regulatory organisations to employ demarcation strategies to preserve and reinforce the independence of their knowledge-making operations. These demarcation efforts are referred to as 'boundary work' within the STS literature.

ii. Boundary work

Coined in the 1980s by the sociologist Thomas Gieryn, the concept of 'boundary work' was further developed by STS scholars as a re-inscription of the 'demarcation problem' with which philosophers and sociologists of science have long grappled. The demarcation problem refers to questions about "how to identify unique and essential characteristics of science that distinguish it from other kinds of intellectual activities."[146] Prominent philosophers of science, including Popper and Merton, have proposed demarcation criteria such as falsifiability and the widespread institutionalisation of certified knowledge (e.g. in universities), respectively. These philosophical approaches to science subscribe to the commonly held idea that standards or norms are the source of science's success and authority as an epistemic domain.[147] By contrast, more recent sociological studies of science have questioned the desirability of strictly demarcating science from non-science. Noting that demarcation is more than just an analytical or heuristic device, Gieryn points to the realities of scientific practice to argue that "demarcation is routinely accomplished in practical, everyday settings."[148]

[145] T.Meyer, n97, 32.
[146] T.Gieryn, n40, 781.
[147] S.Sismondo, n46, 8.
[148] Ibid.

Consequently, Gieryn argues in favour of abandoning ontological-positivistic understandings of the characteristics of science as somehow inherently unique and instead examining them as the product of ideological efforts by scientists to distinguish scientific work from non-scientific work.[149] He accordingly reframes the demarcation problem as 'boundary work,' which refers to the totality of demarcation activities, conceptual tools, and ideological manoeuvres that scientists use to construct and police the social boundaries between science and non-science, for example, the *production* and *consumption* of scientific knowledge.[150] Critically, the discursive manoeuvres made by scientists engaged in the production of policy-relevant or regulatory science, which Gieryn refers to as 'public science,'[151] become intelligible as 'boundary work.' This typically encompasses all efforts to explain their work to non-scientists, particularly the legal and policy communities, to garner resources and public support for their work as well as rhetorical attempts to defend their professional autonomy and "[keep] science autonomous from government controls."[152] Scientists use demarcation tools and techniques to preserve the integrity of their work in the face of epistemic diversity and pluralism. In sum, boundary work tends towards the following three goals: i) the expansion of authority or expertise in particular domains (e.g. environment, public health etc.); ii) the monopolisation of professional authority and resources, and; iii) the protection of autonomy.[153] These are constitutive features of the 'professionalisation' of disciplines including, but not limited to the sciences.

[149] T.Gieryn, n40, 782.
[150] Ibid, 782, 789.
[151] Ibid, 782.
[152] Ibid, 789.
[153] Ibid, 791-792.

For our purposes, the concept of boundary work assists in the identification of the material and social conditions surrounding the networked production of climate science, including particular points or 'nodes' that constitute instances of demarcation between science and politics. Indeed, STS scholars have opined that boundary work has useful policy relevant applications and is pertinent for studying the separation of political and scientific tasks in the advisory relationship between scientists and regulatory agencies.[154] They have also emphasised that where boundaries between science and politics become 'fuzzy' or disappear in practice, there is a need for boundary work to engage in demarcation to maintain clean distinctions and social discipline within each sphere of activity (i.e. science and politics) and establish their authority vis-à-vis one another.[155] Moreover, the legitimacy of each domain is contingent on actors being seen to act within the remit of their authority or jurisdiction.[156]

However, boundary work also helps us understand the hybrid nature of contemporary regulatory activity which comprises a complex mixture of facts and values.[157] It allows us to make sense of how science and policy can forge productive relationships with one another to co-produce expert knowledge and social order while concurrently maintaining their epistemic integrity in accordance with internal systems of accountability. This is made possible through a series of what Star and Griesemer have termed 'boundary objects' which are "relatively stable and reproducible things, people, projects, texts, maps, and ideas that facilitate articulation between different actors and

154 David H. Guston, 'Boundary Organizations in Environmental Policy and Science: An Introduction' (2001) 26 *Science, Technology & Human Values* 4, 399; S.Jasanoff, n139.
155 Clark Miller, 'Hybrid Management: Boundary Organizations, Science Policy, and Environmental Governance in the Climate Regime' (2001) 26 *Science, Technology & Human Values* 4, 492.
156 Ibid, 493.
157 Ibid, 495.

social worlds" and satisfy the informational requirements of each of them.[158] Star and Griesemer add that "their boundary nature is reflected by the fact that they are simultaneously concrete and abstract, specific and general, conventional and customized…and often internally heterogeneous."[159] Their creation and management is crucial for maintaining coherence across intersecting social worlds.[160]

While scientists engage in demarcation efforts, they also deploy boundary objects to garner support for their propositions from the policy community. To that end, they engage in processes of translation or, as Latour and Callon call it, *interessement* to signal the translation of concerns of the non-scientist into those of the scientist.[161] These networked relations between scientific and non-scientific actors/actants are characterized by iterative processes of alliance formation. Ultimately what matters is the "flow of objects and concepts through the network of participating allies [both scientists and non-scientists] and social worlds [science and policy/law]."[162] These collaborative relationships and interactions between science, policy and law (and the range of actors within these domains) form the core of most contemporary regulatory activity.

The concept of boundary work is therefore also a mechanism for examining and understanding climate science not as inherently authoritative and incontestable due to

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158 Simon Shackley & Brian Wynne, 'Representing Uncertainty in Global Climate Change Science and Policy: Boundary-Ordering Devices and Authority' (1996) 21 *Science, Technology & Human Values* 3, 279; Susan Leigh Star & James R. Griesemer, 'Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology' (1989) 19 *Social Studies of Science* 3, 393, 408.

159 S.L.Star & J.R.Griesemer, n158, 408.

160 Ibid, 393.

161 Ibid, 389; B.Latour, n33; Michel Callon, 'Some Elements of a Sociology of Translation: Domestication of the Scallops and Fisherman of St Brieuc Bay' in John Law (ed), *Power, Action, and Belief, Sociological Review Monograph* No.32 (Routledge & Keegan Paul 1985), 196-230.

162 S.L.Star & J.R.Giesemer, n158, 389; B.Latour, n33.

the assumed epistemic superiority of science relative to other disciplines. Rather the use of this STS concept enables a more sophisticated conceptualisation of climate science as an authoritative field of knowledge precisely because it is a product of contestation, struggle, and meticulous processes of alliance formation. More specifically, the outputs of climate science, including the consensus and IPCC assessments, are the hard-won fruits of boundary work painstakingly carried out by climate scientists (with the support of other experts and government professionals as exemplified by the work of the IPCC) over several decades in the face of persistent deconstructionist challenges. The next chapter applies these STS concepts to craft a detailed analysis of the production and framing of IPCC climate science as science for policy and law.

VI. Conclusion

STS-constructivist studies of science offer several conceptual and methodological devices that are invaluable for studying scientific knowledge production and its uses in climate change governance and litigation. These include ANT, co-production, science for action, science for policy, and boundary work. This chapter has demonstrated that both ANT and science for action furnish important modes of critical enquiry that I will pursue in my thesis, namely an examination of the social and material conditions and processes surrounding the production of climate science and the uses to which climate science is being put by actors in legal processes such as litigation. In part, my investigations are motivated by the incompleteness of the STS-Jasanoffian critique of climate science, which does not account for the latent dangers associated with pluralising climate change knowledge production. It has and will be further argued that while STS anxieties about technocracy are well-founded, the STS critique of climate science is not informed by a micro-level examination of the actual knowledge practices

of the IPCC, particularly its assessment cycle and, in that sense, is weakened by what it misses. This omission also appears out-of-sync with STS' strong epistemic orientation towards studying science in action (i.e. as it takes place within transnational networks), which demands more granular analyses of the sites of production and the totality of processes and actors/actants involved. In Chapter Three, I accordingly seek to address this gap in STS scholarship by carrying out a micro-level study of the IPCC.

While the more important question for STS scholars of the science-law nexus is the purposive uses to which science can be put in legal processes, such a question cannot be satisfactorily answered without first turning our attention to the *science in action* question to interrogate precisely how climate science became an authoritative field of study in the first place and, therefore, how its findings and propositions attained the status of consensus. This qualitative assessment, which seeks to understand the basis for the construction of sound or 'good' science, is highly significant in the context of climate change policy which cannot be credibly enacted without data initially derived from climate models. The science *for* action question then becomes relevant and important when investigating the uses or applications of climate science by actors in litigation. Both lines of enquiry are of central importance to this PhD project and are pursued in conjunction, as they enable me to clearly identify the ways in which these actors are synthesising climate science within the IPCC and strategically using it within UNFCCC COPs and domestic courts to co-produce a new *transnational legal commons on climate change*. The next chapter adopts an STS science-in-action (or science-in-the-making) framework, and applies ANT and the co-production idiom to map the IPCC's production and synthesis of climate science. Chapters Four to Six subsequently examine how climate science is co-produced and applied in legal settings, namely by being evaluated,

certified and disseminated by courts and litigants in climate change lawsuits. They also explore the by-product of this co-production in the form of a shared body of transnational climate change case law.

CHAPTER THREE

The IPCC's Synthesis of Climate Science as Applied Knowledge

I. Introduction

In this PhD project, I argue that climate science is being generated through transdisciplinary co-production between the domains of science, policy and law and the key actors steering this process include climate scientists, domestic courts and climate litigants. The byproduct of these co-productive dynamics is an emergent transnational and shared body of legal practice and jurisprudence on climate change, as illustrated in Chapters Five and Six. This chapter shows that the Intergovernmental Panel on Climate Change (IPCC) is the first major site for the transdisciplinary co-production of climate science. Actors of many different stripes including scientists, social scientists, policymakers and legal professionals, are involved in the IPCC's knowledge-making enterprise. I argue that the IPCC's knowledge practices evidence instances of both *'science-policy co-production'* and *'science-law co-production,'* as exemplified by certain certification procedures like peer review, the adoption and approval of IPCC reports, and their integration into and application within the UNFCCC regime, respectively. This chapter applies an STS, science-in-action framework, comprising Actor Network Theory (ANT) and the co-production idiom, to document how the knowledge base and scientific consensus on climate change are produced and synthesised through scientific-epistemic networks and certified through the work of the IPCC and its Working Groups. It aims to identify and map the processes through which the IPCC's assessment reports (i.e. its particular framing of climate science) have

become an authoritative body and primary source of expert knowledge for actors in climate litigation, as shown in Chapters Four to Six.

The IPCC is the pre-eminent intergovernmental organisation for the "[assessment] of scientific, technical and socio-economic information relevant to understanding the scientific basis of the risk of human-induced climate change."[1] Its authority and influence on climate change law and policymaking are considerable. The IPCC continually justifies its work by reference to its United Nations mandate. According to its official rhetoric, it strives to preserve its legitimacy by always operating exclusively in the scientific domain and remaining policy-neutral.[2] Examining this claim, it is clear however that scientific authority is only one form of authority that the IPCC currently exercises. The IPCC also has a policy-advisory function and its high level decision-making procedures involve extensive governmental participation. It is therefore best thought of as "a science-policy boundary organisation"[3] or "hybrid management body."[4] However, according to some constructivist and STS scholars, the IPCC's insistence on its scientific purity and its technoscientific construction of climate change as a predominantly environmental problem has precluded its concomitant framing as a social problem.[5] This critique will be closely examined and addressed.

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1 IPCC, Intergovernmental Panel on Climate Change, 'Principles Governing IPCC Work' (2015) *IPCC.ch* </http://www.ipcc.ch> accessed 27 November 2015.
2 Ibid; Bert Bolin, *A History of the Science and Politics of Climate Change: The Role of the Intergovernmental Panel on Climate Change* (CUP 2007).
3 David H. Guston, 'Boundary Organizations in Environmental Policy and Science: An Introduction' (2001) 26 *Science, Technology, & Human Values* 4, 400.
4 Clark Miller, 'Hybrid Management: Boundary Organizations, Science Policy, and Environmental Governance in the Climate Regime' (2001) 26 *Science, Technology, & Human Values* 4, 478.
5 Andreas Bjurström & Merritt Polk, 'Physical and economic bias in climate change research: a scientometric study of the IPCC Third Assessment Report' (2011) 108 *Climatic Change* 1, 1; Sheila Jasanoff, "A New Climate for Society," (2010) 27 *Theory, Culture & Society*, 233; Clark Miller, 'Climate science and the making of a global political order,' in Sheila Jasanoff (ed), *States of Knowledge:The Co-production of Science and Social Order* (Routledge 2004) pp.46-66.

To date, much of the research on the IPCC has been carried out by STS scholars and a handful of critical social scientists.[6] With some important exceptions,[7] the IPCC has received little attention from legal scholars as a subject worthy of study in its own right. This lacuna in the legal literature is perplexing given the prominence of the IPCC in the international legal regime on climate change, namely the United Nations Framework Convention on Climate Change (UNFCCC) and Conference of the Parties (COPs). The central preoccupation of existing legal studies on the IPCC is with the issue of accountability.[8] Academic criticism of the IPCC's ostensible failure to foreground minority or dissenting opinions in its reports[9] is overstated. Studies that advocate this view do not pay close attention to the IPCC's actual assessment procedures, whereby disagreement and differences of expert opinion are canvassed and explicitly recorded in its reports following intensive rounds of scientific and political scrutiny, dialogue and debate.[10]

This chapter proceeds on the premise that evaluative studies seeking to measure the IPCC's accountability exclusively by reference to political-legal criteria (transparency, participation etc.) are not entirely appropriate given its hybrid character and dual responsibility of maintaining both scientific credibility and political legitimacy. The IPCC is required to respond to the demands and live up to the expectations of both the

6 Mike Hulme & Martin Mahoney, 'Climate Change: What do we know about the IPCC?' (2010) 14 *Progress in Physical Geography* 1, 1.
7 S.Jasanoff, n5, 233; Tara Skodvin, 'Science-policy interaction in the global greenhouse: Institution design and institutional performance in the Intergovernmental Panel on Climate Change (IPCC)' (1999) CICERO Working Paper No.3; Danielle Hanna Rached, 'The Intergovernmental Panel on Climate Change: Holding Science and Policy-Making to Account' (2014) 24 *Yearbook of International Environmental Law* 1; Oren S. Perez, "The Hybrid Legal-Scientific Dynamic of Transnational Scientific Organisations," (2015) 26 *The European Journal of International Law* 2.
8 D.H.Rached; O.S.Perez, Ibid.
9 O.S.Perez, n7, 145.
10 Appendix A to the Principles Governing IPCC Work, hereafter 'Appendix A' (15-18 April 1999) 15th session, Rule 4.2.5.

scientific and policy communities, which are sometimes contradictory and irreconcilable – a core existential tension. This chapter seeks to address this gap in the legal scholarship on climate change by adopting a constructivist approach[11] and, to that end, importing relevant insights from philosophical and sociological studies of science and STS scholarship. It also seeks to contribute to the legal literature on climate change by assessing the implications of the IPCC's epistemic authority and its particular framing of climate change for law and policymaking generally and legal processes such as litigation in particular.

This chapter also contends that climate science is best thought of as 'applied science,' and 'trans-science' as understood by STS scholars.[12] This is because it is being generated and shaped predominantly in response to policy demands and, occasionally, failed or pending climate litigation. More importantly, with climate change causation presenting profound challenges for adjudication, the production of event attribution science appears to be partly driven by the demands of legal process. This is largely consistent with the agenda-based character of climate science and IPCC assessments which have always been produced with the intent of informing public policy.

The analysis is laid out according to the following schema. Part II maps the emergence and development of climate science as a discrete, albeit multidisciplinary, field of study. It also closely examines and addresses scholarly claims from STS-constructivists that the dominant technoscientific narrative of climate change is deficient and that climate

[11] Sheila Jasanoff, 'Is science socially constructed? – And can it still inform public policy?' (1996) 2 *Science and Engineering*, 263.
[12] Alvin M. Weinberg, 'Science and Trans-science' (1972) 10 *Minerva* 2; Sheila Jasanoff, 'Representation and Re-presentation in Litigation Science' (2008) 116 *Environmental Health Perspectives* 1.

science is afflicted by a crisis of narrativisation. Parts III and IV document the transformation of climate science into a knowledge base for policy and law through the work of the IPCC. These sections will specifically map the institutional personality and governance role of the IPCC by paying close attention to its organisation, functions, and knowledge practices and develop a typology of the different forms of authority that it exercises. Part III determines whether the IPCC can be classified as a boundary organisation. Part IV examines in detail the IPCC's assessment procedures and mechanisms and thereby determines whether its knowledge practices typify boundary work. It also examines the IPCC's relationship to the UNFCCC regime. The UNFCCC is characterised as a site of *science-law co-production*. Part V makes a case for why climate science inherently lends itself to practical application and is therefore best thought of as a body of: i) applied science and; ii) trans-science. Through these modes of analysis, the chapter demonstrates that the IPCC occupies a central and indispensable position within the global climate change regime complex, as the principal provider of a broad knowledge base for policymaking, litigation and norm creation on climate change. More specifically, IPCC assessment reports have become an important source and repository of expert knowledge for actors in climate litigation and play a formative role in transnational judicial lawmaking on climate change. Part VI offers some concluding remarks.

II. Climate Science in Context

The exceptional character of climate science

The IPCC consensus on the anthropogenic causes of climate change[13] has gained near universal acceptance from states as embodied by the 2015 Paris Agreement. While scientific uncertainties persist in relation to the manifestation of future impacts of climate change, the climate science community largely operates from a common set of well-founded assumptions and consensually established facts when advising policy communities about climate change matters. The battle lines over climate change tend to play out almost entirely in the political arena and pertain to the adoption of regulatory responses to the problem – a reality that courts have and continue to affirm.

A shared objective of all scientific enquiry is to investigate and acquire knowledge about our world. However, not all scientific fields are equivalent in terms of their methods of knowing, predictive capabilities, and levels of certainty. Environmental sciences[14] such as 'ecology'[15] are generally characterised by higher levels of uncertainty and indeterminacy.[16] Predictions about the future state of an ecosystem are often framed in probabilistic terms and, in some areas, unpredictability reigns.[17] Climate science, while also framed in terms of varying levels of probability, differs from other environmental sciences because it is heavily dominated by the physical sciences, namely Earth Systems

[13] IPCC, 'Fifth Assessment Report (AR5): The Physical Science Basis' (2013) *IPCC.ch* <https://www.ipcc.ch/report/ar5/wg1/> accessed 15 November 2015; The IPCC Working Group I concluded with 97% confidence that the current atmospheric concentration of anthropogenically emitted GHGs amounts to 400ppm.

[14] Ecological science or 'ecology' is the branch of biology that studies the relationships between living organisms and their environment. Oxford English Dictionary, 'Ecology,' (2020) < https://www.oed.com/view/Entry/59380?redirectedFrom=ecology#eid> accessed 3 February 2020.

[15] Environmental sciences involves the interdisciplinary scientific study of the environment and environmental problems and include scientific fields such as ecology. Oxford English Dictionary, 'Environmental Science' (2020) < https://www.oed.com/view/Entry/281235?redirectedFrom=environmental+science#eid> accessed 3 February 2020.

[16] Richard A. Carpenter, 'Ecology in Court, and Other Disappointments of Environmental Science and Environmental Law' (1983) 15 *Natural Resources Law* 3, 586.

[17] Ibid, 591.

Science[18], which is a relatively high-consensus field.[19] Physical sciences combine high levels of experimental data and probabilistic modelling, which tend to reduce the potential for conflict and disagreement.[20] In contrast, the environmental sciences mainly comprise mixed, though well-founded, probabilistic science.[21]

There are usually far more theoretical disagreements in ecology than in physics. For example, in relation to environmental impact statements (EIS) and environmental questions concerning unmanaged ecosystems, scientists in court often disagree. This is not the case with climate science, since over the last two decades, thousands of climate scientists around the world have been running the same climate models (i.e. Global Circulation Models or 'GCMs') and deriving very similar or identical results about atmospheric and oceanic warming and its anthropogenic causes. Climate scientists have also been forthright in their identification and acknowledgement of flaws within existing climate models,[22] which they constantly strive to improve. Nevertheless, through iterative simulations of GCMs, climate science has developed into a mature scientific field that exhibits greater levels of predictive capability and reduced uncertainty. By contrast, ecological sciences have relatively lower levels of predictive capability, which has resulted in important aspects of EIS remaining inherently uncertain.[23]

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[18] Earth Science or Earth Systems Science (ESS) takes the main components of planet Earth—the atmosphere, oceans, freshwater, rocks, soils, and biosphere—and seeks to understand major patterns and processes in their dynamics. It studies not only the processes that go on within each component (traditionally the realms of oceanography, atmospheric physics, and ecology, to name but three), but also interactions *between* these components. It is the need to study and understand these between-component interactions that defines ESS as a discipline in its own right. See John Lawton, 'Earth System Science,' (2001) 292 *Science* 5524, 1965.

[19] R.A.Carpenter, n16, 591.

[20] Ibid, 588.

[21] Ibid, 589.

[22] Myles Allen, 'The Scientific Basis for Climate Change Liability' in Richard Lord QC, Silke Goldberg, Lavanya Rajamani, Jutta Brunnee (eds), *Climate Change Liability: Transnational Law and Practice* (CUP 2012) 10.

[23] R.A.Carpenter, n16, 590.

Another crucial difference between other environmental problems and climate change is the absence of national or global ecological surveys in relation to the former, as exemplified by the National Environmental Policy Act (NEPA) regime in the US.[24] NEPA does not mandate continual assessment efforts to improve the quality and utility of EIS. Climate change is again uniquely situated within the highly diverse field of environmental and ecological issues, because the IPCC is exclusively empowered by states to engage in the sustained and rigorous accumulation, synthesis, and assessment of state-of-the-art climate science from around the world and consolidate a global database. As shown below, the IPCC assessment cycle is marked by high levels of quality control due to its sophisticated peer review system.

Scientific uncertainty has long been used by regulators, politicians, and climate change detractors as a rationale for indefinitely deferring climate action, particularly in the US. However, against the backdrop of the Paris Agreement and the growth of climate science, any regulatory position that advocates in favour of inaction or a business as usual approach on climate change is arguably untenable, morally dubious, and politically irresponsible. Climate inaction is now both an unmitigated social ill and a deficient policy position. Some legal scholars rightly envisage that governments which pursue a business as usual approach and major carbon producers that continue their GHG emitting activities with the knowledge that they are contributing to dangerous anthropogenic climate change would be unable to rely on private law defences based on well-established tort principles to counter arguments likely to be made by plaintiffs in

[24] R.A.Carpenter, n16, 593.

the second half of this century.[25] These include the following: i) serious damage occurred; ii) it was known that such damage would occur (according to IPCC assessments) and could have been prevented (according to the Stern Review), and; iii) the principal emitters chose not to act effectively, primarily in order to derive short-term economic benefits.[26] Therefore, governments and corporations which assume such a position remain exposed to an array of legal challenges, which will become increasingly difficult for them to counter as the scientific evidence on climate change damage and attribution mounts.

The expulsion of scientific uncertainty has become a raison d'etre and hallmark of climate science as both a field of study and a knowledge base for regulation and policy. However, uncertainty remains inherent to the problem of climate change and therefore poses challenges for climate science.[27] GCMs are not capable of predicting and mapping the contours of *all* future impacts with a high degree of precision and accuracy due to a myriad of unknown variables.[28] Moreover, climate scientists have occasionally experienced difficulties in effectively communicating uncertainty to laypersons. The IPCC has proved particularly adept at bridging this communication divide by providing accessible and intelligible explanations to lay audiences about how uncertainty is accounted for and indicated in the assessment reports. This is exemplified by the Fifth Assessment Report (AR5) on the Physical Science Basis in which the IPCC enumerates the key metrics that the Working Groups use to communicate uncertainty, namely: i) a

[25] Richard Lord QC, Silke Goldberg, Lavanya Rajamani, Jutta Brunnee (eds), *Climate Change Liability: Transnational Law and Practice* (CUP 2012) 36.
[26] R.Lord QC et al, n25, 36.
[27] U. Cubasch, D. Wuebbles, D. Chen, M.C. Facchini, D. Frame, N. Mahowald, and J.-G. Winther, '2013: Introduction,' in Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)] (CUP, 2013) 123.
[28] Ibid.

qualitative scale of confidence in the validity of a finding, and; ii) a quantified measure of uncertainty expressed probabilistically.[29]

The issue of scientific uncertainty dominated the first wave of climate litigation cases,[30] and remains relevant where specific impacts are concerned, but will need to be rethought as the science of event attribution[31] grows and strengthens. During the first wave of climate litigation, GHG emissions presented a conundrum for causal proof and the attribution of liability. Much of the early scholarship on climate litigation subscribes to this line of thought, arguing that the (then) inadequate state of scientific knowledge on climate change made it difficult to prove specific causation in a court of law.[32] While this was accurate for its time, such jurisprudential and scholarly positions appear increasingly outmoded in light of significant advances in climate science – an issue discussed in more detail in Chapter Six. Indeed, Carpenter observes that scientific knowledge as a base for law may change quickly and radically.[33] Therefore, an account

[29] IPCC AR5, n13. With respect to the first metric of confidence, the following five qualifiers are used: very low, low, medium, high, very high. In relation to the second metric, the following terms are used to indicate the assessed likelihood of an outcome or a result: Virtually certain 99-100% probability; Very likely 90-100%; Likely 66-100%; About as likely as not 33-66%; Unlikely 0-33%; Very unlikely 0-10%; Exceptionally unlikely 0-1%.

[30] Ganguly et al. characterize the first wave of climate litigation as comprising strategic public and private climate litigation brought against governments and fossil fuel corporations between 2005 and 2015 and largely concentrated in the United States. Geetanjali Ganguly, Joana Setzer & Veerle Heyvaert, 'If At First You Don't Succeed: Suing Corporations for Climate Change' (2018) 38 *Oxford Journal of Legal Studies* 4, 846.

[31] Event attribution science or Probabilistic Event Attribution (PEA) is an emerging branch of climate science concerned with assessing and quantifying the extent to which extreme weather events can be linked to past anthropogenic GHG emissions, also known as 'attributable risk.' Friedereke Otto, Rachel James & Myles Allen, 'The science of attributing extreme weather events and its potential contribution to assessing loss and damage associated with climate change impacts,' (2018) <https://unfccc.int/files/adaptation/workstreams/loss_and_damage/application/pdf/attributingextremeevents.pdf> accessed 8 April 2019; See Sophie Marjanac & Lindene Patton, 'Extreme weather event attribution science and climate change litigation: an essential step in the causal chain?' (2018) 36 *Journal of Energy and Natural Resources Law* 3.

[32] David A. Grossman, 'Warming Up To a Not So Radical Idea: Tort-based Climate Change Litigation' (2003) 28 *Columbia Journal of Environmental Law* 1, 6; Erica D. Kassman, 'How Local Courts Address Global Problems: The Case of Climate Change' (2012) 24 *Duke Journal of International Law* 201.

[33] R.A. Carpenter, n14, 578.

of how the current state of climate science is shaping and affecting contemporary climate litigation is needed and this PhD project provides one such account.

The dominant technoscientific narrative of climate change

Climate science is a branch of the atmospheric sciences and a sub-discipline within the Earth Sciences which includes, *inter alia*, climatology, meteorology, oceanography, physics and biogeochemistry.[34] Climate scientists study the structure and dynamics of the Earth's climate system to understand how global, regional, and local climates are maintained as well as the processes by which they are altered.[35] All these scientific fields have contributed to our knowledge about climate change. While studies on global warming have existed since the late nineteenth century,[36] climate change became a distinct subject of scientific study mainly in the United States in the 1960s and crystallised into a full-fledged global scientific research program only in the late 1980s and early 1990s. Disagreements between climate scientists at the time, particularly between James Hansen at NASA and other climatologists, also signalled the need for "a much more stringent approach to the assessment of all available knowledge,"[37] and culminated in the creation of the IPCC and the initiation of its first assessment cycle in 1988.

While scientific assessments on climate change predated the establishment of the IPCC, and were largely carried out by US government agencies such as the National Academy

[34] Stanford Encyclopedia of Philosophy, 'Climate Science' (2018) <https://plato.stanford.edu/entries/climate-science/> accessed 3 February 2020.
[35] Ibid.
[36] English scientist John Tyndall developed the concept of the 'greenhouse effect' in 1865. Swedish physicist, Svante Arrhenius, built on this legacy and became the first scientist to consider the effects of anthropogenic carbon emissions from fossil fuel exploitation on the climate.
[37] Bert Bolin, n2, 49.

of Sciences (NAS), the IPCC represented the first forum in which governments sought to link and foster interactions between the scientific and political communities with respect to climate change. Moreover, the scientific consensus on the anthropogenic roots of climate change emerged in 2001 with the publication of the IPCC's Third Assessment Report (AR3).[38] Similarly, the most recent AR5 reflects an overwhelming consensus (97%) among the climate science community on the links between anthropogenic GHG emissions and climate change.[39]

Seminal pieces of climate change research that have over time informed IPCC assessments and shaped the scientific consensus include James Hansen's 'Model Zero' and Michael Mann's 'Hockey Stick Graph.' Published in 1988, Model Zero was one of the world's first climate models to demonstrate the link between anthropogenic carbon emissions and atmospheric warming.[40] Michael Mann's 1999 Hockey Stick Graph relied on climate proxy records to map the mean temperature of the past 500 to 2000 years (paleoclimate reconstructions) and revealed a rapid and unprecedented warming pattern in the 20th century.[41] Both have since proven to be accurate in their predictions. Indeed, GCMs now constitute the principal tools used by climate scientists to map atmospheric and oceanic temperature changes resulting from anthropogenic GHG emissions. They also continue to heavily inform IPCC assessments which constitute the core output of the global climate science community. Consequently, IPCC assessments

[38] IPCC, 'Third Assessment Report' (2001) *IPCC.ch* < https://www.ipcc.ch/assessment-report/ar3/> accessed 25 February 2016.
[39] IPCC AR5, n13.
[40] J Hansen, I Fung, A Lacis, D Rind, S Lebedeff, 'Global climate changes as forecast by Goddard Institute for Space Studies three-dimensional model' (1988) 8 *Journal of Geophysical Research* 93.
[41] Michael E. Mann, Raymond S. Bradley & Michael K. Hughes, 'Northern Hemisphere Temperatures During the Past Millennium: Inferences, Uncertainties, and Limitations' (1999) 26 *Geophysical Research Letters* 6.

can be thought of as embodying or reflecting the dominant scientific narrative of climate change since the turn of the twenty-first century.

The narrative power of climate science

Climate change is different from other issues due to its unique spatial, scalar, and temporal dimensions. It is a polycentric and totalising phenomenon, significant enough to influence the classification of a new geological epoch – the 'Anthropocene' – to denote the central role of humans in shaping the Earth's climate and the environment (biosphere) since the industrial revolution in the late 18th century.[42] Climate change affects everyone, transcending geographical demarcations (i.e. the territorialised nation-state) and dissolves distinctions between global and local.[43] Of all contemporary issues, it is more high stakes than any other since inaction is fatal and has deleterious planetary consequences. As German philosopher Peter Sloterdijk argues, Buckminster Fuller's 'Spaceship Earth' metaphor has compelling applications in the climate change context.[44] Sloterdijk suggests that in this monadological conceptualisation of the Earth as a 'spaceship,' regardless of whether one supports the status quo of fossil fuel exploitation or advocates in favour of ecological moderation, the goal of atmospheric stabilisation for the sake of collective survival has become an absolute imperative.[45]

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[42] Paul J. Crutzen, 'Geology of mankind' (2002) 415 *Nature* 23; Will Steffen, Paul J. Crutzen & John R. McNeill, 'The Anthropocene: Are Human Now Overwhelming the Great Forces of Nature?' (2007) 36 *Ambio* 8, 615. In May 2019, the Anthropocene Working Group, a constituent body of the International Commission on Stratigraphy, decided by a majority vote (and after extensive and vigorous debate) to adopt the 'Anthropocene' as a formal unit of geological time, understood as beginning in the 1950s with the onset of the nuclear age and the vast accumulation of stratigraphic content since. Nicola Davidson, 'The Anthropocene epoch: have we entered a new phase of planetary history?' *The Guardian* (30 May 2019) < https://www.theguardian.com/environment/2019/may/30/anthropocene-epoch-have-we-entered-a-new-phase-of-planetary-history> accessed 13 June 2019.

[43] Peter Sloterdijk, 'How big is big?' (2010) <http://www.collegium-international.org/index.php/en/contributions/127-how-big-is-big> accessed 10 August 2017.

[44] Ibid.

[45] Ibid.

If this account of Earth as a spaceship is accepted, then Earth scientists occupy a unique position as 'reformers,'[46] acting as principal advocates of a decarbonised future. In other words, Sloterdijk alludes to the way in which Earth scientists are already wedded to a particular narrative or framing of climate change which they have actively played a part in globalising. In doing so, he claims that they are promoting an ethics of moderation or a politics of climatic socialism.[47] However, Sloterdijk acknowledges that the most compelling account of climate is the one provided by Earth scientists.[48] The scientific account of climate change is powerful precisely because of its unparalleled predictive capabilities or what Sloterdijk refers to as 'prognostic intelligence.'[49] Indeed, the technoscientific narrative of climate change that the IPCC assessments carry forward not only document existing impacts, but are also framed as prognoses or predictions of harm scenarios, some of which have since come to pass and others which are yet to materialise. In contrast, social scientific discourses and narratives on climate change do not possess similar prognostic capabilities. With respect to the narrative power of science, former scientist Michael Segal offers the following reflections:

> Some narratives are more powerful than others. Scientific narratives are some of the most powerful of all. They teach us more than facts, mechanisms, and procedures. They convey a worldview of skeptical empiricism and indefinite revision, and show us how to negotiate the boundary between our rational and emotional selves, teach us to suspend judgment and consider all the possibilities, and remind us that a belief in objective truth is a deep kind of optimism with massive dividends. Perhaps most important of all, they situate us in the world.[50]

[46] P.Sloterdijk, n43.
[47] Ibid
[48] Ibid.
[49] Ibid.
[50] Michael Segal, 'The Missing Climate Change Narrative' (2017) 116 *The South Atlantic Quarterly* 1, 123.

A crisis of narrativisation?

The core narratives of climate science, as embodied by IPCC assessments, have come under fire in recent years for failing to resonate with lay-publics and influence meaningful policy responses to climate change. Is a more compelling climate science 'meta-narrative'[51] needed to better inform policy and garner public attention with respect to climate change? This section evaluates these claims, including normative proposals for reforming climate science narratives and the role of climate scientists with respect to policymaking. It argues that climate scientists are sufficiently attuned to the narrative deficiencies of their knowledge outputs. Indeed many prominent climate scientists are already playing non-traditional roles and have spearheaded high profile climate advocacy efforts in recent years in their capacity as both expert witnesses in litigation and activists.

The scientific account of climate change has not always succeeded in garnering widespread public support or influencing the development of policy responses to the problem. Certain scholars partly attribute this to the absence of compelling narratives around uncontested scientific facts. The facts produced by climate scientists are insufficient on their own to inspire climate action. In this regard, Segal suggests that better scientific storytelling is required to bridge the gap between science and culture.[52] Climate scientists are also aware of this problem, with James Hansen famously referring

[51] Ibid; Chris Rapley, Kris de Meyer & Sarah Chaytor, 'Time for Change? Climate Science Reconsidered,' (June 2014) Report of the UCL Policy Commission on Communicating Climate Science < https://www.ucl.ac.uk/public-policy/sites/public-policy/files/migrated-files/Communication_of_Climate_Science_policy_briefing_FINAL.pdf> accessed 15 February 2018; Roger A. Pielke Jr, *The Honest Broker: Making Sense of Science in Policy and Politics* (CUP 2007).
[52] M.Segal, n50, 124.

to the 'timid language of scientific probabilities' as scientific reticence.[53] Several commentators have accordingly called for the development of a more powerful 'meta-narrative' of climate science.[54]

According to Rapley, such a narrative must be fundamentally premised on the rejection of the linear 'technocratic model' that currently dominates the science-policy paradigm towards a 'co-production' model.[55] Rapley further argues that climate scientists and policymakers must work collaboratively with one another as well as other experts and members of the public to develop a more holistic 'co-production' approach to the issue.[56] This would also ensure that climate science achieves greater credibility in the eyes of lay-publics.[57] Pielke and Rapley also suggest that climate scientists ought to take on new roles and responsibilities with respect to policymaking and public engagement. Notable recommendations include the roles of i) a 'science communicator' who engages with society to convey their results and offer interpretations of those results; ii) an 'the honest broker of policy alternatives' who contributes scientific expertise to climate-related decision-making and, along with other stakeholders, fully evaluates all available options, thereby engaging in a process of co-production and; iii) an 'issue advocate' who engages with decision-makers and the public to promote a particular course of action, justified on the basis of their expert knowledge and understanding.[58]

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[53] See James Hansen as quoted in a New York magazine article by David Wallace-Wells, 'The Uninhabitable Earth' *New York Magazine* (July 2017) < http://nymag.com/daily/intelligencer/2017/07/climate-change-earth-too-hot-for-humans.html> accessed 9 July 2017.

[54] C.Rapley et al, n51; R.A. Pielke Jr, n51; M.Segal, n50, 122.

[55] C.Rapley et al, Ibid, 25.

[56] Ibid.

[57] Ibid.

[58] Chris Rapley & Kris de Meyer, 'Climate science reconsidered' (2014) 4 *Nature Climate Change*, 746; R.A.Pielke Jr, n51.

The stakes involved in recasting scientific narratives

The contention that scientific facts need to be made more palatable for public consumption does not on its own adequately explain political inaction on climate change. A crucial question missed by those demanding better narratives from climate science, as exemplified by the STS perspectives of Jasanoff and others discussed in Chapter Two, is what is at stake if constructivist or 'deconstructionist' approaches enter into knowledge-making processes pertaining to climate change? In short, as discussed in Chapter Two, this perspective does not adequately account for the pernicious influence of climate denial on public opinion through its organised assault on climate science. While in contemporary societies, technoscientific propositions and innovations are increasingly subject to processes of public scrutiny and validation, the constituent elements of what Ulrich Beck terms 'reflexive modernization,'[59] deconstructionist approaches and methodologies pose unique problems in relation to climate change. As Demeritt rightly observes, "the controversy over climate change suggests that public exposure of scientific uncertainty is not always the politically progressive or reflexive liberation of politics, law and the public sphere from their patronization by technocracy."[60] Furthermore, STS-constructivism does not enable us to call out climate denial as a lie; rather it becomes a 'point of view.'[61] Climate deniers have long been invested in a campaign to systematically discredit IPCC assessments and have already tried to deconstruct (albeit unsuccessfully) the Hockey Stick Graph.[62] With the backing of the fossil fuel industry, climate deniers have managed to use deconstructionist

[59] Ulrich Beck, 'From industrial society to the risk society: questions of survival, social structure, and ecological enlightenment' (1992) 9 *Theory, Culture & Society* 97_123; Ulrich Beck, *Risk Society: Towards a New Modernity* (Sage Publications 1992).
[60] David Demeritt, 'Science studies, climate change, and the prospects for constructivist critique' (2006) 35 *Economy and Society* 3, 460-461.
[61] Ibid, 460.
[62] D.Demeritt, n60, 462. Climate skeptics cherry-picked paleo-climatic data to countenance Michael Mann's hockey stick graph and its conclusion that recent (i.e. 20th century) warming is unprecedented. Such denialist views were subsequently amplified by right-wing think tanks and media outlets.

approaches to successfully sow doubt and sustain a campaign of organised public skepticism about climate science, particularly in the US.

In short, what is perhaps most at stake here is knowledge itself, specifically knowledge production and the IPCC's control over the climate change narrative. Litigation on climate change is proliferating precisely because there is a desire among various actors to control the narrative, since such control elicits or translates into particular regulatory outcomes. Law acts as a powerful certification mechanism in this context. More specifically, scientific narratives require social justification[63] and litigation is one mechanism through which this might occur. The present vulnerability of the technoscientific narrative of climate change cannot be ignored given that climate deniers are once again in power in the US. The IPCC narrative, although dominant, is again being threatened by systematic assaults on climate science and vicious attacks against climate scientists by deniers. Therefore, careful consideration and caution are required when advocating in favour of modifying the climate change narrative through constructivist approaches in order to accommodate alternative epistemological perspectives.

The attack on expertise and science, as evidenced by the Trump Administration's efforts to defund and muzzle government scientific agencies, means that scientists (particularly those employed by US government agencies like NAS, NASA and NOAA) may lose control of the climate change narrative altogether, which would prove profoundly counterproductive to collective action on the issue. In light of these sobering political realities, reflexive modernisation with respect to climate change requires us, at a

[63] M.Segal, n50, 124.

minimum, to vigorously defend 'good' science and unequivocally disavow 'bad' science and climate denial.[64] More specifically, the core propositions of climate science (particularly as reflected in the physical science volume of IPCC assessments) might need to be placed beyond deconstructionist scrutiny and dissection of the kind that is liable to misappropriation by climate deniers. The key implication here is that the core set of scientific propositions about climate change constitutes an epistemic baseline from which to regulate the problem.

Climate science advocacy: "Litigate-to-Mitigate"[65]

The assaults on IPCC climate science have prompted some prominent climate scientists to defend their work by engaging in climate activism and advocacy to promote climate science narratives through public interviews and lectures, documentary films, literature and, increasingly, litigation. In recent years, high profile climate science advocacy efforts have largely been carried out by public figures and celebrities. Salient examples of such advocacy through narrative include documentary films by Al Gore and Leonardo DiCaprio.[66] Climate-themed fiction or 'cli-fi' is also a rapidly growing sub-genre of science fiction literature, rendered compelling by the authors' direct reliance on climate science projections for the construction of plausible post-climate futures.[67] These works touch on a range of important climate-related subjects such as water scarcity, forced

[64] D.Demeritt, n60, 474.
[65] Jonathan Watts, 'We should be on the offensive" – James Hansen calls for wave of climate lawsuits,' *The Guardian* (17 November 2017) < https://www.theguardian.com/environment/2017/nov/17/we-should-be-on-the-offensive-james-hansen-calls-for-wave-of-climate-lawsuits> accessed 17 November 2017.
[66] Al Gore's 'An Inconvenient Truth' (2006) and 'An Inconvenient Sequel: Truth to Power' (2017); Leonardo Dicaprio's 'Before the Flood'(2016).
[67] Livia Albeck-Ripka, 'Is Climate-Themed Fiction All Too Real? We Asked the Experts' *New York Times* (26 September 2017) < https://www.nytimes.com/interactive/2017/09/26/climate/climate-books-fiction-scifi-novels.html?hp&action=click&pgtype=Homepage&clickSource=story-heading&module=second-column-region&region=top-news&WT.nav=top-news> accessed 26 September 2017; The recent Pulitzer prize winning book 'The Overstory' by Richard Powers is a salient example of a climate change novel. See Richard Powers, *The Overstory* (Penguin Randomhouse 2018).

human displacement, species extinction and sea-level rise. Climate scientists are increasingly participating in climate advocacy as reflected by their occasional collaboration with filmmakers and novelists on the issue.[68] Moreover, the election of Donald Trump has spurred the American scientific community into strongly voicing its concerns about renewed attacks on science and expertise and threats to evidence-based policymaking. The March for Science in May 2017 marks the largest assembly of scientists participating in organised protest against the US government in recent history.[69]

While such political mobilisation and advocacy by scientists is on the rise, many prominent climate scientists have led similar efforts in the past decade. Perhaps the most high profile example of climate science advocacy includes that undertaken by former NASA climatologist James Hansen who is often referred to as the 'father of global warming.'[70] Hansen's Model Zero predicted much of what has now come to pass regarding climate change and many climate impacts have also surpassed his initial projections. According to Hansen, dangerous anthropogenic interference with climate system would constitute atmospheric CO_2 levels of 350 parts per million (ppm).[71] In September 2016, this threshold was significantly exceeded with CO_2 levels crossing 400 ppm. Hansen regularly attends protests (e.g. Keystone XL Pipeline) and has been arrested numerous times for his activism. He is also one of the plaintiffs and key expert

[68] L.Albeck-Ripka, n67; For example, Barbara Kingsolver, author of 'Flight Behaviour,' consulted biologist Lincoln Bower, an expert on monarch butterflies and their population decline as a consequence of environmental degradation, including climate change.
[69] Nicholas St Fleur, 'Scientists, feeling under siege, march against Trump policies' *New York Times* (22 April 2017) <https://www.nytimes.com/2017/04/22/science/march-for-science.html > accessed 22 April 2017.
[70] Elizabeth Kolbert 'The Catastrophist: NASA's climate expert delivers the news no one wants to hear' *The New Yorker* (26 June 2009) < https://www.newyorker.com/magazine/2009/06/29/the-catastrophist> accessed 20 August 2017.
[71] E.Kolbert, n70.

witnesses in the recent landmark Oregon District Court case, *Juliana et al v USA*[72] (popularly referred to as the Our Children's Trust case), a lawsuit brought on behalf of his granddaughter and future generations against the US government for its failure to adequately regulate the GHG emissions of the fossil fuel industry. Hansen has also provided expert testimony in another major US climate change lawsuit *Green Mountain Chrysler Plymouth Dodge Jeep v Crombie*.[73] In view of such impassioned climate science advocacy, the charge against climate scientists for being predominantly technocratic and clinical in their production and circulation of climate science is not borne out or, at the very least, shows that there are exceptions to the rule. Hansen's advocacy is a marked example of a sincere and considered effort to mobilise scientific data derived from climate models to create a climate change narrative that clearly seeks to drive societal change.

Hansen has also been candid and forthcoming about his advocacy efforts.[74] For example, in a 2009 protest in Washington D.C., in an interview with the New Yorker, he stated the following: "I'm trying to make clear what the connection is between the science and the policy…somebody has to do it."[75] His colleague, climatologist Michael Oppenheimer notes, "[Hansen's] made up his mind that you have to pull out all the stops at this point, and that all his scientific efforts would come to naught if he didn't also involve himself in political action."[76] From 2007, Hansen began writing to world leaders, including Prime Minister Gordon Brown of Britain, and Yasuo Fukuda, then

[72] *Kelsey Cascadia Rose Juliana et al. v. United States of America et al* (2016) Case No. 6:15-cv-01517-TC.
[73] *Green Mountain Chrysler Plymouth v Crombie*, 508 F. Supp. 2d 295 (D. Vt. 2007).
[74] See Hansen's TED Talk from 2012. James Hansen, 'Why I must speak out about climate change' *TED* (2012) < https://www.ted.com/talks/james_hansen_why_i_must_speak_out_about_climate_change> accessed 3 October 2017.
[75] E.Kolbert, n70.
[76] Ibid.

the Prime Minister of Japan. In December 2008 he composed a personal appeal to Barack and Michelle Obama. Science historian Naomi Oreskes notes that Hansen's advocacy is striking for its moral language: "Hansen talks in stronger terms. He's using adjectives. He has started to speak in moral terms, and that always makes scientists uncomfortable."[77] Hansen also delivers PowerPoint presentations with the disclaimer that any statements relating to policy are his personal opinion.

In 2017 Hansen and his team authored a scientific paper titled '*Young People's Burden'* with the public trust climate change lawsuit *Juliana v USA*[78] (discussed in Chapters Four and Six) directly in mind. The study's four key findings include the following: i) global warming in the past 50 years has raised the global temperature well above the prior range of the Holocene to the level of the Eemian period when sea level was 6-9 metres higher than today; ii) global warming can be held below 1.5°C (the aspirational goal of the Paris Agreement) if rapid reductions of global CO_2 emissions (at least 3% a year) begin by 2021 and there is no net growth of other climate forcings. However, 1.5°C exceeds estimated Eemian temperature and is not an appropriate goal; iii) the growth rate of greenhouse gas climate forcing has accelerated markedly in the past several years, and; iv) an appropriate goal is to return the global temperature range to the Holocene range within a century. To realise this 'negative CO_2 emissions' scenario, an immediate and drastic reduction in GHG emissions is required coupled with improved agricultural and forestry practices including reforestation and technological extraction of CO_2 from the air.[79]

[77] See Naomi Oreskes as quoted in E.Kolbert, n79.
[78] *Kelsey Cascadia Rose Juliana et al. v. United States of America et al* (Our Children's Trust Case) (2016) Case No. 6:15-cv-01517-TC, 4.
[79] James Hansen et al, 'Young people's burden: requirement of negative CO2 emissions' (2017) 8 *Earth System Dynamics* 1, 577-578,

Other prominent climatologists with notable public-facing climate advocacy roles include Will Steffen and Michael Mann. Will Steffen is a chemist and an expert on Earth System Science and the former Inaugural Director of the Climate Change Institute at the Australian National University from 2008 to 2012, where he is now an emeritus professor. He has delivered a series of public lectures on climate science over the last decade, including TED talks, in which he has repeatedly urged the Australian government to pursue more meaningful action on climate change.[80] Steffen also recently appeared as an expert witness in the landmark Australian (New South Wales) case pertaining to a development proposal for an open cut coalmine, *Gloucester Resources v Minister for Planning*.[81] His testimony was pivotal to the assessment of climate change impacts of the proposed Rocky Hill coalmine in this case and is discussed in detail in Chapter Five.

Similarly, Michael Mann has also publicly advocated in favour of science-based policy interventions on climate change. He is a climatologist and geophysicist and the current director of the Earth System Science Center at Pennsylvania State University. He is also a member of the board of 'The Climate Mobilization,' a US grassroots advocacy group calling for national economic mobilization against climate change, geared towards reaching net zero emissions by 2025.[82] Upon directly experiencing the impacts of the 2019 to 2020 Australian bushfires, Mann penned an op-ed for the Guardian on 1 January

[80] Will Steffen, 'Climate Change 2018: The Nature of the Challenge' (2018) <https://www.youtube.com/watch?v=g-jk5vJowtA> accessed 4 February 2020; Will Steffen, ' TedXCanberra: The Anthropocene' (2010) < https://www.youtube.com/watch?v=ABZjlfhN0EQ> accessed 4 February 2020.
[81] *Gloucester Resources Ltd v Minister for Planning* (2019) 234 LGERA 257.
[82] Michael Mann, 'Time to Mobilize: Michael Mann for Climate Mobilization' (27 December 2018) < https://www.theclimatemobilization.org/blog/a-message-from-michael-mann-time-to-mobilize> accessed 4 February 2020.

2020 in which he declared "I am a scientist on holiday in the Blue Mountains, watching climate change in action"[83] and ardently pleaded with Australians to "vote out fossil-fuelled politicians who have chosen to be part of the problem."[84]

In *Merchants of Doubt*, Oreskes and Conway astutely document the ways in which prominent climate scientists have been persecuted by the fossil fuel industry and climate deniers over the last three decades.[85] Other scholarly accounts have attributed the persecution of climate scientists to 'ideological thinking' and 'conspiratorial ideation.'[86] This involves an approach to social or scientific phenomena as a matter of individual 'belief,' the rejection of scientific propositions, including the fundamentals of climate science, and the tendency to "explain significant political or social events as a secret plot by powerful individuals or organisations."[87] In the US, the muzzling of government climate scientists even has its own moniker – being "Hansenized."[88] In a manner analogous to the former Bush Administration, the Trump Administration regards climate scientists in particular as a threat to the dominance of special interests and the fossil fuel status quo which it actively supports and sustains. Its scientific skepticism and efforts to undermine government scientists attests to the latter's (perhaps relatively newfound) power and influence as a political force to be reckoned with, particularly with respect to climate change. The exponential rise in lawsuits against climate scientists

[83] Michael Mann, 'Australia your country is burning – dangerous climate change is here with you now' (1 January 2020) < https://www.theguardian.com/commentisfree/2020/jan/02/australia-your-country-is-burning-dangerous-climate-change-is-here-with-you-now> accessed 1 January 2020.
[84] Ibid.
[85] Naomi Oreskes & Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (Bloomsbury Press 2010).
[86] Stephan Lewandowsky, John Cook, Klaus Oberauer, Scott Brophy, Elisabeth A. Lloyd and Michael Marriott, 'Recurrent Fury: Conspiratorial Discourse in the Blogosphere Triggered By Research on the Role of Conspiracist Ideation in Climate Denial,' (2015) 3 *Journal of Social & Political* Psychology 1, 143.
[87] Ibid.
[88] N.Oreskes et al., n85.

by denialist groups (many of them funded by the fossil fuel industry) since the 2016 US election[89] is symptomatic of the anti-science sentiment that is now endemic within the White House and other branches of the US government.

Climate litigation is another platform for climate science advocacy, where concerted efforts are being made by climate scientists and litigants to legitimate, protect and defend the technoscientific narrative of climate change and the core findings of climate science (i.e. IPCC assessments) from assault by industry, government and denialist groups. In the context of climate litigation, I argue that climate science advocacy takes the form of recurrent appearances by climate scientists as expert witnesses and *amicus curiae,* and litigants' use of climate science to craft compelling rights and climate justice-based narratives. Therefore, climate litigation remains an important front-line strategy among the climate science community and civil society for the promotion and dissemination of the IPCC's technoscientific narrative of climate change. Such efforts are also demonstrative of science-law co-production since scientists and litigants are often collaborating to use litigation to co-produce and elevate the IPCC's technoscientific narrative of climate change. These dynamics are mapped and unpacked in Chapters Five and Six.

[89] The civil society advocacy group, Climate Science Legal Defense Fund (CSLDF), which represents climate scientists in lawsuits, recently reported that frivolous lawsuits against climate scientists by climate denialist think tanks and front groups have risen significantly since the 2016 election. In general, many of these climate denialist groups have been emboldened by the Trump administration. Lauren Kurtz, 'Climate scientists are under attack from frivolous lawsuits' *The Guardian* (7 July 2016) <https://www.theguardian.com/environment/climate-consensus-97-per-cent/2016/jul/07/climate-scientists-are-under-attack-from-frivolous-lawsuits> accessed 20 August 2017.

III. The IPCC's Institutional Personality

Although it does not conduct research itself, the IPCC is responsible for reviewing and framing the current state of scientific knowledge on climate change.[90] This section will attempt to map the contours of the IPCC's institutional personality and specifically determine whether it merits the title of a 'boundary organisation.' The IPCC is a transnational network or 'epistemic community'[91] comprising experts (both scientific and otherwise) and government representatives from around the world. While its membership is diverse and multinational, all members subscribe to and engage in the shared epistemic enterprise of producing policy relevant knowledge on climate change. Its United Nations mandate prescribes that its primary role is to review and assess the current state of scientific and technical knowledge on the anthropogenic basis of climate change and prepare policy-neutral and policy-relevant reports.[92] Its organisational principles also prescribe a support role for the IPCC within UNFCCC processes (e.g. COPs), which are the main sites of international regulatory activity on climate change.[93]

The IPCC's procedures and outputs indirectly influence norm creation and policymaking. It was designed to have considerable influence on international regulatory processes as an upstream producer of knowledge and policy advice. The IPCC's dominance in relation to scientific knowledge production is a consequence of

[90] IPCC, 'Organization' (2016) < http://www.ipcc.ch/organization/organization.shtml> accessed 18 January 2016.
[91] Peter Haas defines an epistemic community as a network of professionals with recognised expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue area. They share a set of normative and principled beliefs, which provide a value-based rationale for the social action of community members, causal beliefs, notions of validity, and a common policy enterprise. See Peter M. Haas, 'Introduction: epistemic communities and international policy coordination' (1992) 46 *International Organization* 1, 3.
[92] IPCC Principles, n11, Principles 2 & 3.
[93] Ibid, Principle 1.

states' (particularly the US') conscious efforts to depoliticise the climate change issue within their national jurisdictions by centralising and concentrating epistemic authority in one principal institution at the international level.[94] Through its epistemic dominance and consensus, the IPCC continues to inform international (UNFCCC), supranational (EU) and national law- and policymaking on climate change from a position of relative independence. Such institutional design choices also evince the underlying intention of states and other UN bodies[95] to vest the IPCC with significant epistemic authority and influence in relation to international standard setting processes under the auspices of the UNFCCC. For example, at COP 3, member states (i.e. Annex I parties) translated the IPCC's consensus on the anthropogenic basis of climate change into a legally binding agreement, the Kyoto Protocol.

Some legal commentators have also characterised the IPCC as a 'regulatory scientific institution' – a particular breed of transnational organisation innovated in "response to the demand in modern societies for scientific certainty and to the scarcity of normative resources in the international domain."[96] The IPCC merits the label of a regulatory scientific institution because it seeks to apply scientific and technical knowledge to a specific problem area in transnational governance and advises legal institutions such as the UNFCCC about the current state of scientific knowledge on the issue.[97] It also engages in internal standard-setting and self-regulation, having adopted sophisticated rules of procedure that govern the admissibility, treatment, and formal acceptance and

[94] Shadur Agrawala, 'Context and early origins of the Intergovernmental Panel on Climate Change' (1998) 39 *Climatic Change* 605, 617.
[95] Along with the US, UNEP and WMO co-founded the IPCC.
[96] O.S.Perez, n7, 392.
[97] Timothy Meyer, 'Epistemic Institutions and Epistemic Cooperation in International Environmental Governance' (2013) 2 *Transnational Environmental Law* 1, 17.

approval of scientific and technical reports on climate change.[98] Its peer review procedures are particularly comprehensive and rigorous, even more so than those for most academic journals, with no direct analogue in transnational governance.[99] Since its inception in 1988, the IPCC has also periodically strengthened and expanded its peer review procedures in response to criticism and to expel potential bias. Its work has considerable influence on transnational regulatory processes pertaining to climate change. Through over two decades of inter-institutional engagement and practice, its knowledge work has arguably become the *sine qua non* of law and policymaking on climate change.

At the intersection of science and politics: A Janus-faced entity?

The IPCC's claims to scientific purity are consistent with what Latour describes as the modern drive towards the purification of hybrids into science or politics and facts or values.[100] Despite such claims, the IPCC can be appropriately characterised as a science-policy 'boundary organisation'[101] or 'hybrid management body.'[102] Boundary organisations are those situated between two social worlds such as science and politics, and can be used by individuals within each for specific purposes without losing their own identity.[103] They consist of social arrangements, networks and institutions that mediate between the institutions of science and politics.[104] The IPCC is a paradigmatic example of a global governance institution engaged in boundary work, which comprises the production of "regulatory science [through] advisory processes loaded with value

[98] Appendix A, n10, Rule 4.
[99] Shadur Agrawala, 'Structural and process history of the Intergovernmental Panel on Climate Change' (1998) 39 *Climatic Change* 623-624.
[100] Bruno Latour, *We have never been modern* (Harvard University Press 1993).
[101] D.Guston, n3, 399.
[102] C.Miller, n4, 486.
[103] D.Guston, n3, 400 ; C.Miller, n4.
[104] C.Miller, n4, 482.

judgments."[105] Therefore, it is a site of what STS scholars like Latour and Jasanoff have termed 'co-production,' which involves the simultaneous production of knowledge and social order.[106]

Legal scholars like Oren Perez agree with the STS characterisation of regulatory scientific institutions (RSIs) as exercising hybrid epistemic-scientific and political-legal authority.[107] However, he goes slightly further, arguing that the STS terminology (i.e. boundary organisation, boundary work and co-production) does not sufficiently capture the unique hybrid dynamic and institutional complexity within RSIs.[108] More specifically, these metaphors are not adequately attuned to the institutional tensions within RSIs produced by the juxtaposition of the discourses of science, law and politics.[109] Accordingly, he posits that RSIs like the IPCC have a 'triple-hybrid structure' comprising three complementary pairs - science-law, law-non-law, and science-pseudo science.[110] The hybrid structure of RSIs produces existential tensions by virtue of the fact that they are subject to parallel and competing systems of scientific and legal-political accountability, which may come into conflict. RSIs are therefore torn between the conventions of science (with its focus on intellectual merit and objectivity) on the one hand and law-politics (with its emphasis on voice, participation, and transparency) on the other.[111]

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105 Sheila Jasanoff, 'Watching the watchers: lessons from the science of science advice' *The Guardian* (8 April 2013) < http://www.theguardian.com/science/political-science/2013/apr/08/lessons-science-advice> accessed 20 January 2016.
106 D.Guston, n3, 401; Bruno Latour, *Science in action: How to follow scientists and engineers through society* (Harvard University Press 1987); Sheila Jasanoff, n11, 396.
107 O.S.Perez, n7, 392.
108 Ibid.
109 Ibid, 403.
110 Ibid, 412.
111 Ibid, 404.

Perez's contribution here is important as it moves away from a binary characterisation of RSIs as simply scientific-political organisations, to provide a more nuanced account of hybridity within this particular new breed of transnational institutions. However, his characterisation of RSIs as 'triple-hybrid organisations' does not constitute a radical departure from the STS literature on boundary organisations, but rather builds on the legacy of such scholarship to expand upon the concept of boundary work. In this regard, it is closely aligned with Clark Miller's work which reformulates and updates the concept of boundary organisations into the notion of 'hybrid management,' which more pertinently captures the contemporary dynamics of global governance. Miller defines 'hybrid management' as the processes by which boundary organisations secure internal cohesion and maintain productive relationships between domains by "putting scientific and political elements together [hybridisation], taking them apart [deconstruction], establishing and maintaining boundaries between different forms of life [boundary work], and coordinating activities taking place in multiple domains [cross-domain orchestration]."[112] A common denominator of all these conceptual-theoretical frameworks is the concept of *hybridity*, which is sufficiently flexible to apply to a range of institutions engaging in regulatory activity beyond the state. The present study will therefore rely on this more flexible concept of hybridity to map the authority of the IPCC.

Between facts and values: The IPCC as the archetypal hybrid institution

The IPCC exhibits the classical traits of a boundary organisation or hybrid management body as theorised by Miller.[113] It is a site of co-production in the sense that it

[112] C.Miller, n4, 487.
[113] Ibid.

simultaneously serves as a forum for scientific knowledge-making and the development of policy responses to climate change – a form of socio-political ordering. Although scientific assessments constitute a major component of its mandate, its work is not purely scientific. Rather, its institutional structure reflects its hybrid existence or "dual agency"[114] as both a scientific and legal-political organisation. On the one hand, the scientific limb of the IPCC's mandate is carried out by WGI, which is responsible for reviewing and assessing the current state of scientific knowledge on climate change.[115] On the other hand, WGII and WGIII are respectively tasked with assessing climate change impacts and developing responses,[116] and thereby routinely engage in non-scientific knowledge work, which has obvious socio-political dimensions and implications.

The work of both WGII and WGIII involves extensive appraisal of climate equity issues such as vulnerability and socio-economic impacts – subject matter which by its very nature invites value judgments. In addition, the IPCC's review work involves the extensive participation of, and liaison and collaboration between scientists, other experts (i.e. economists and legal professionals) and government representatives. While the first stage of peer review is reserved exclusively for independent experts, participation in the second stage is open to experts, authors of the draft reports, and all WMO and UN member states.[117] Similarly, experts and government representatives are joint participants in the Working Group Panels where they collectively approve and accept the final draft reports.[118]

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[114] D.Guston, n3, 401.
[115] IPCC, 'Working Groups/Taskforce' (2016) < http://www.ipcc.ch/working_groups/working_groups.shtml> accessed 19 January 2016.
[116] Ibid.
[117] Appendix A, n10, Rules 4.1 & 4.2.
[118] Ibid.

These joint interactions represent the coalescence of science and politics, which is aptly exemplified by one of the IPCC's key outputs, the Summaries for Policymakers (SPMs), which contain scientific content, but are also politically negotiated products.[119] Processes leading to the adoption of the SPMs attest to the Janus-faced character of the IPCC, as they are pertinent examples of boundary work or hybrid management practices that combine scientific and political input. The SPMs are authored by scientists and subsequently adopted by consensus at the Plenary sessions of each Working Group after undergoing a rigorous and comprehensive review process by governments and independent experts, involving line-by-line approval.[120] Given such extensive governmental and political participation in its processes, some commentators have observed that the IPCC's maintenance of its image as scientific is slightly paradoxical.[121] The following section will identify the ways in which the IPCC's organisational structure and procedures attempt to harmonise and balance the dual imperatives of scientific independence and political inclusivity.

IV. The IPCC's Key Procedures and Functions

The foregoing analysis establishes the IPCC's status as a transnational environmental regulator and a boundary-hybrid management organisation. It also demonstrates that the IPCC is not a monolith. The label 'scientific organisation' is a misnomer, as it fails to adequately capture its institutional complexity. Rather, the IPCC comprises a plethora of actors (numerous categories of experts and governmental representatives) that

119 Larry S. Luton, 'Climate Scientists and the Intergovernmental Panel on Climate Change: Evolving Dynamics of a Belief in Political Neutrality' (2015) 37 *Administrative Theory & Praxis* 152.
120 Appendix A, n10, 4.3.
121 T.Skodvin, n5, 29; L.S.Luton, n119, 145.

participate in variegated and dynamic processes of knowledge-making and definitional work, as evidenced by the existence of three discrete working groups. This section closely examines the practices of the Working Groups (WGs), clarifies the status of the IPCC's principles and rules of procedure, and also provides a comprehensive account of its assessment reporting structure and functions including: i) preparation of reports; ii) peer review, and; iii) acceptance, approval and adoption of reports. It also provides concrete examples of the IPCC's hybrid management activities or boundary work, which evidence its exercise of both scientific and legal-political authority.

Status of IPCC principles and rules of procedure

The IPCC was established in 1988 by UNEP and the WMO under the auspices of the UN through General Assembly (GA) Resolution 43/53.[122] Although GA resolutions are generally thought to be non-binding and recommendatory in international law,[123] the ICJ has held them to be authoritative and, in limited cases, binding.[124] GA resolutions are generally binding in relation to organisational matters within the UN legal order (*rationae materiae*) and on their valid addressees (*rationae personae)*, which can include member states and other UN bodies.[125] The GA's authority *rationae materiae* arguably extends to the establishment of other UN bodies such as the IPCC.

WMO Council Resolution 4 also prescribes the IPCC's initial mandate and terms of reference, which assigns it responsibility for assessing scientific information on

[122] UNGA Res 43/53 (6 December 1988).
[123] *South West Africa (Ethiopia v S Africa; Liberia v S Africa) (Second Phase)* [1966] ICJ Rep 6 at 50–51, para. 98.
[124] *Competence of the General Assembly for the Admission of a State to the United Nations* [1950] ICJ Rep 4, at 8.
[125] *Certain Expenses of the United Nations (Article 17, Paragraph 2, of the Charter)* [1962] ICJ Rep 151, at 163–164

greenhouse gases to enable evaluation of the consequences of climate change, formulating response strategies, and reporting on its activities to UNEP and WMO.[126] These resolutions form the basis of the Principles Governing IPCC Work, which were adopted in 1998 in Vienna and have been periodically amended and updated,[127] as well as its appendices, which enumerate the rules of procedure.[128] Principle 1 is expressed in mandatory language and prescribes that, "the IPCC *shall* concentrate its activities on tasks allotted by the relevant WMO and UNEP Governing Council resolutions and decisions…"[129] Thus, even if not legally binding, the IPCC principles and rules of procedure derive from a combination of GA Resolution 43/53 and UNEP and WMO Governing Council Resolutions and therefore have at least a quasi-legal character.

The IPCC Assessment Cycle

IPCC assessments are the most salient examples of boundary work, as they embody the tension between the IPCC's role as scientific knowledge producer and policy advisor. This tension is produced by the IPCC's status as a boundary organisation, which is concurrently subject to scientific and political systems of accountability that inevitably pull in different directions. Nomenclature aside, the IPCC's assessment work is situated between the scientific and political realms, which means that it must mediate between the respective imperatives of remaining committed to notions of scientific truth and credibility on the one hand and the claims of interest, power, and legitimacy on the other.[130] The IPCC attempts to strike a balance between these competing imperatives

126 WMO Executive Council Res 4 EC-XLII (22 June 1990).
127 IPCC Principles, n11.
128 Appendix A, n10.
129 IPCC Principles, n11, Principle 1.
130 Bernd Siebenhuner, 'The changing role of nation-states in international environmental assessments – the case of the IPCC' (2003) 13 *Global Environmental Change*, 113; Sheila Jasanoff, *The Fifth Branch* (Harvard University Press 1990).

through its sophisticated and hybrid institutional organisation and procedures, which enable instances of both scientific-technical independence (deconstruction and boundary demarcation) and science-policy integration (hybridisation and cross-domain orchestration).[131] Prominent examples of the former include the initial assessment of relevant and up-to-date research, the compilation of reports, and the first stage of peer review. All three are the exclusive province of scientists and other experts. Examples of the latter include the later stages of peer review and acceptance, approval and adoption of reports, which involves extensive participation by and collaboration between scientists, other experts and governmental representatives. A more detailed examination of these procedures follows in turn.

i. Preparation of reports

The IPCC divides its work of collating and assessing the credibility of relevant scientific, technical, and socio-economic research, and preparing reports among three principal WGs and a Taskforce on National Greenhouse Gas Inventories. WGI is tasked with assessing the science of climate change, WGII's mandate extends to assessing the socio-economic impacts of climate change and WGIII is responsible for developing response strategies relating to mitigation and adaptation.[132] The Taskforce is responsible for developing a methodology for calculating and reporting national greenhouse gas emissions and removals.[133]

The general structure of the initial assessments and drafting of reports is uniform across the three WGs and Taskforce. First, the WG and Taskforce Bureaux select Coordinating

[131] C.Miller, n4, 487.
[132] IPCC, 'IPCC Structure' (2016) < http://www.ipcc.ch/organization/organization_structure.shtml> accessed 11 February 2016.
[133] Ibid.

Lead Authors (CLAs), Lead Authors (LAs), and Contributing Authors (CAs) based on recommendations from governments, NGOs, the IPCC Secretariat, and participating organisations (e.g. UNEP and WMO) that identify and provide a list of appropriate experts.[134] Second, the WG and Taskforce Bureaux select authors from the lists provided with the aim of ensuring diversity and geographical representation in membership (including authors from developing countries) and scientific, technical, and socio-economic views and backgrounds.[135]

Third, CLAs and LAs are tasked with preparing the first draft of all assessment reports. In doing so, they are required to assess peer reviewed and internationally available literature, which includes unpublished manuscripts and selected non-peer-reviewed or 'grey' literature (e.g. industry journals, working papers, internal organisational publications etc.).[136] Authors must typically prioritise peer-reviewed sources, but can justify their use of non-peer reviewed literature in accordance with Annex 2 of the rules of procedure.[137] This provides guidance on how to treat non-peer-reviewed literature, which has to be: i) critically assessed for quality and validity; ii) listed in the reference sections of IPCC reports and; iii) submitted to the WG/Taskforce Bureau Co-Chairs who coordinate the Report in order to ensure procedural transparency.[138]

Finally, LAs are obliged to record any disagreement by "clearly [identifying] disparate views for which there is significant scientific or technical support."[139] In addition, they

134 Appendix A, n10, Rule 4.2.1.
135 Ibid, Rule 4.2.2.
136 Ibid, Rule 4.2.3.
137 Ibid, Rule 4.2.3.
138 IPCC, 'General Guidance on the Use of Literature in IPCC Reports' (hereafter Annex 2) (2015) <https://nofrakkingconsensus.files.wordpress.com/2013/02/ipcc_greyliterature-gn.pdf> accessed 15 February 2016.
139 Ibid.

generally work in small groups and are assigned to a designated section of the report. LAs also have primary responsibility for synthesising available literature and developing text that is scientifically, technically, and socio-economically sound and faithfully represents a wide range of expert views as far as possible. CLAs also share these responsibilities, but have the additional tasks of: i) coordinating various components of the report and ensuring their completion to a high standard; ii) identifying cross-cutting scientific and technical issues within the report and ensuring that they are addressed in a coherent manner and; iii) overseeing the timely delivery of the report to the WG/Taskforce Bureaux. There are also hundreds of CAs in the assessment cycle, who assume a support function of preparing technical information in the form of text, graphs, or data for assimilation by the LAs. The hundreds of expert authors who participate in the assessment and report drafting processes are drawn from many of the 193 UN member states and work in a voluntary capacity. The most recent AR5 involved the contribution of 831 experts from around the world across the three WGs.[140] In aggregate, the IPCC assesses and reviews a vast body of literature numbering in the thousands over the course of each reporting cycle. In AR5, WGI's report contained over 9200 references to scientific publications, WGII's report contained 12,000, and WGIII's report cited close to 10,000 references.[141]

In WGII and WGIII, the initial assessment of scientific-technical research and the drafting of reports are carried out by expert teams comprising both scientists and social scientists. Both the natural and social sciences have collective input in the assessment of scientific and technical data and drafting of reports, which exemplify interdisciplinary

[140] IPCC, 'IPCC Factsheet: How does the IPCC select its authors?' (2015) < http://www.climatechange2013.org/images/uploads/FS_select_authors.pdf> accessed 15 February 2016.
[141] IPCC, 'Fifth Assessment Report: WG Factsheets' (2016) < http://www.ipcc.ch/report/ar5/wg1/> accessed 10 February 2016.

and cross-domain integration. WGII and WGIII also conduct regional assessments and reflect on socio-economic conditions within particular societies and communities most vulnerable to climate change. Accordingly, they operate somewhere in the realm between science and pseudo-science.[142] For example, in the Fourth Assessment Report (AR4) and AR5, WGII and WGIII identify certain populations as particularly vulnerable to climate change and emphasise both the urgency and moral imperative of assisting those populations through North-to-South transfers of climate finance and technology.[143] In AR5, WGII uses targeted case studies that draw upon social science literature to highlight the vulnerability of particular regions and countries. Since the Second Assessment Report (SAR), a separate chapter has also been devoted to a discussion of Small Island States.

Scientometric studies of the IPCC's Third Assessment Report (TAR) have revealed that WGII is the most integrated of the three working groups, as its draws on literature from both the natural and social sciences, albeit with the balance tipped in favour of the former which retain a dominant influence.[144] By contrast, the social sciences (particularly economics) dominate the work of WGIII.[145] To a lesser extent, the WGs also draw upon legal, political science, sociological, and anthropological research. The STS critique about the absence of interpretive social sciences in knowledge-making processes pertaining to climate change is therefore not entirely borne out in practice.

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142 O.S.Perez, n7, 404.

143 IPCC, 'Fourth Assessment Report: Impacts, Adaptation and Vulnerability' (2007) < https://www.ipcc.ch/report/ar4/wg2/> accessed 15 January 2016; IPCC, 'Fifth Assessment Report: Impacts, Adaptation and Vulnerability' (2014) < https://www.ipcc.ch/report/ar5/wg2/> accessed 15 January 2016.

144 Scientometric studies is a research field that measures, analyses and evaluates science, mainly from statistics based on scientific texts indexed in databases. Andreas Bjurström & Merritt Polk, 'Physical and economic bias in climate change research: a scientometric study of the IPCC Third Assessment Report' (2011) 108 *Climatic Change* 1, 2, 10.

145 Ibid,11.

WGI differs from its counterparts, as its membership and work constitute marked examples of boundary demarcation. Its mandate is limited to determining the physical science basis of climate change. It is therefore not surprising that scientists dominate its membership and retain exclusive prerogative to assess scientific and technical data and author its assessment reports. Its authorial team is made up of a range of scientists, including climatologists, oceanographers and meteorologists. WGI also heavily prioritises literature from a particular sub-field of the physical sciences, namely the Earth Sciences (geosciences, oceanography, and meteorology).[146] Journal content analyses of the TAR have revealed that three-quarters of the total literature referenced was from the Earth Sciences, with environmental sciences and biology making up the remainder.[147]

ii. Peer review

Peer review is the cornerstone of the IPCC assessment cycle, designed to ensure that expert knowledge is credible, accurate, and unbiased as far as possible. It is a well-established certification mechanism that is widely used in both the natural sciences and other academic disciplines. Peer review is a highly distributive and iterative process, typically involving extensive back-and-forth between authors, referees, and review editors, several rounds of revision, and eventually an outcome agreeable to all parties.[148] In the natural sciences, it is often a blind or double-blind process whereby the anonymity of the author and referees is maintained throughout. Peer review is not without

146 A. Bjurström et al, n144, 10.
147 Ibid.
148 Paul N. Edwards & Stephen H. Schneider, 'Chapter 7: Self-governance and Peer Review in Science for Policy: The Case for the IPCC Second Assessment Report' in Clark Miller & Paul N. Edwards (eds) (MIT Press 2001) 10, 8.

controversy and its reliability as an indicator of research quality has been questioned and challenged. Common criticisms include those of confirmation bias and taint due to particular funding agendas.[149] However, Edwards and Schneider observe that such criticism is often underpinned by a lofty and idealised view of peer review as a 'truth machine.'[150] They rightly argue that peer review is a human process, vital to building any coherent knowledge community, and its fundamental purpose is not to derive 'truth,' but rather to *improve* the quality of research by subjecting it to criticism and evaluation by those best qualified to do so.[151] Other significant objectives of peer review include the minimisation rather than resolution of academic disagreement and establishment of the credibility of expert knowledge.[152]

The IPCC procedural rules for peer review appear to embody the purposive goal of informational improvement through disagreement, constructive debate, and critique rather than truth creation. They outline the aim of gathering the *best possible* scientific and technical advice for inclusion in the reports to ensure that they reflect the latest scientific, technical, and socio-economic findings as comprehensively as possible.[153] The IPCC further elaborates the aim of achieving "scientific excellence, balance, and clarity" through multiple stages of review, which are an essential part of its review process to ensure "comprehensive, objective, and transparent assessment of the current state of knowledge of the science related to climate change."[154]

[149] P.N.Edwards et al, n148, 9.
[150] Ibid,10.
[151] Ibid.
[152] Ibid, 11.
[153] Appendix A, n10, Rule 4.2.4.
[154] IPCC, 'IPCC Factsheet: How does the IPCC review process work?' (2016) < https://www.ipcc.ch/news_and_events/docs/factsheets/FS_review_process.pdf> accessed 16 February 2016.

As with authors, Review Editors (REs) and Expert Reviewers (ERs) are similarly selected from lists provided by governments, NGOs, the IPCC Secretariat and participating organisations. The selection process also aims for geographical representativeness and a wide range of views and expertise.[155] While two REs are assigned to each chapter of the reports, hundreds of ERs participate in the review process as a whole. REs are responsible for assisting the WG/Taskforce Bureaux in the selection of ERs, ensuring that all research is appropriately considered, advising authors on how to manage controversial issues, and ensuring that controversies and differences of opinion are included in the text of the reports, particularly if they are relevant to policy debate.[156] ERs perform peer review functions akin to those found in established scientific and other academic journals, primarily commenting on the accuracy and completeness of the scientific, technical, and socio-economic content in the IPCC draft assessment reports.[157]

The first stage of peer review involves a process of scientific-academic certification of the IPCC assessment reports and represents an instance of boundary demarcation. It is similar to peer review processes found in academic journals, albeit on a much grander scale. Participation is exclusively reserved for experts.[158] The First Order Drafts are widely circulated to ERs for evaluation. While performing their evaluation, ERs are also entitled to request any material referenced in the document under review.[159] They subsequently provide their comments to the LAs through the relevant WG/Taskforce Bureau.[160] A process of consultation between ERs, WG/Taskforce Bureau Co-Chairs,

[155] Appendix A, n10, Rule 4.2.4.
[156] Ibid, Rule 4.2.5.
[157] Annex 2 to IPCC Principles, n1, para 4.
[158] Appendix A, n10, Rule 4.2.4.1.
[159] Ibid.
[160] Ibid.

CLAs, and the IPCC Secretariat may be held to specifically address particular points of assessment or major areas of difference.[161] Based on the review comments, author teams prepare Second Order Drafts and a first draft of the SPMs. The second and final stages of review involve both experts and governments[162] who provide comments to facilitate the preparation of the Final Draft Reports and SPMs by the author teams for Plenary acceptance, approval, and adoption. These later stages of review are apt examples of integration and cross-domain orchestration, as they culminate in the political certification of the IPCC assessment reports and SPMs.

iii. Acceptance, approval, and adoption of reports

The IPCC procedures for acceptance, approval, and adoption of reports constitute prominent examples of collaboration and integration between the scientific and political communities. Following the second stage of review and redrafting, the assessment reports and SPMs are submitted to the plenary of each WG for acceptance and approval, respectively.[163] These plenaries mainly comprise national delegations that include government officials and policymakers, and also involve the participation of LAs (i.e. experts). In WGI plenary sessions, LAs retain a special status and considerable influence, as any proposed changes to the text of the report cannot be made without their consent. It is also at the plenary sessions that controversial issues or disagreements are addressed through a series of side meetings to enable arrival at a consensus. These side meetings consist of an intensive science-policy dialogue, allowing government officials and experts to reopen and settle disputes over certain sections of the reports or SPMs, generally by developing revised text. However, the finally approved product seldom

[161] Appendix A, n10.
[162] Ibid, Rule 4.2.4.2.
[163] Assessment reports are accepted, SPMs are approved, and Synthesis Reports are adopted; IPCC Principles, n1, Principle 2.

tends to differ substantially from the draft text, due to a pattern of political deference towards expertise in WG plenary sessions. While consensus approval of assessment reports occurs in a highly polarised and politicised environment, government representatives generally tend to defer to the scientific authority of experts.[164]

These plenary discussions are critical as "they represent the first step towards acquiring political acceptance of the knowledge base [on climate change] and its conclusions."[165] Having undergone an intensive process of scientific-political scrutiny, the assessment reports and SPMs emerge as robust and scientifically credible documents that are approved by WG plenary consensus. Therefore, as Skodvin astutely observes, the substantive conclusions that arise out of these plenary discussions are not easily deconstructed.[166] More specifically, once accepted by the WG plenaries, the full panel plenary of the IPCC cannot subsequently amend a report. This is an important institutional safeguard established through a revision of the IPCC rules of procedure in 1993 and designed to ensure consistency between the assessment reports and SPMs.[167] The main task of the panel plenary is to review the reports, record any substantial disagreements, and formally accept them.[168] SPMs undergo a separate process of approval by government delegates, who are the main actors in that process. LAs do not directly participate in this process, but retain an advisory role. SPMs are subjected to intensive political scrutiny, namely line-by-line discussion among government delegates who approve them by consensus. The procedural safeguard discussed above also ensures

164 T.Skodvin, n7, 21.
165 Ibid.
166 Ibid.
167 Ibid, 22.
168 IPCC, 'IPCC Factsheet: How does the IPCC approve reports?' (2016) < https://www.ipcc.ch/news_and_events/docs/factsheets/FS_ipcc_approve.pdf> accessed 18 February 2016.

that controversial issues addressed and settled at the WG plenary sessions cannot be reopened during the SPM approval process. The panel plenary is also responsible for the section-by-section review and adoption of the Synthesis Report (of which SPMs are a subset), which synthesises and integrates materials contained in the assessment reports in a non-technical style accessible to policymakers.[169]

Institutional reform

The IPCC is an innovative beast, whose hybridity and high level of procedural flexibility allow it to concurrently operate as both a scientific and policy advisory body, without the bureaucratic encumbrances typical of other regulatory institutions. Its assessment procedures exemplify both boundary work and co-production *par excellence*. As Rached observes, "there is hardly an international body, with a similar institutional task, that has attained this level of procedural meticulousness."[170] While each assessment cycle may involve a credibility crisis or trial,[171] the IPCC nonetheless manages to perform its multifaceted role with a certain degree of success and with its credibility and authority largely intact.

This is attributable to its rather sophisticated procedural architecture, which it has developed and fine-tuned over time through institutional learning in response to outside criticism, to preserve its authority and credibility in the eyes of its main audiences (i.e. scientists and governments). Most notably, following a series of crises in 2009,[172] the

169 Appendix A, n10, Rule 4.4.1.
170 D.H.Rached, n7, 24.
171 Ibid, 18.
172 In 2009, the World Wildlife Fund identified errors in the data in AR4 on Himalayan glaciers. In the same year, Contributing Authors from the University of East Anglia were also discovered to have manipulated data to exaggerate the urgency of a particular climate change scenario - a crisis that became known as 'Climategate.' D.H. Rached, n7, 19.

IPCC commissioned the InterAcademy Council (IAC), a multinational organisation of science academies, to audit its procedures in order to strengthen its capacity to respond to future challenges and improve the quality of its reports.[173] The IPCC's sophisticated assessment procedures can therefore be ascribed to its uptake and enforcement of IAC recommendations (2010), particularly in relation to the treatment of uncertainty, and the fortification of its review process to minimise the possibility of future errors.

The IPCC's relationship to the UNFCCC

This section examines the extent to which the IPCC and its knowledge outputs are integrated into the UNFCCC and Conference of the Parties (COPs). It is argued that the final stage of certification or authentication of IPCC assessments is legal and occurs: i) at the UNFCCC level, and; ii) through climate change litigation. Moreover, both are key sites of science-policy-law co-production. The judicial treatment of IPCC reports as expert evidence in climate change litigation is an extensive topic, which merits separate treatment and will therefore be addressed in the following two chapters.

The relationship between the IPCC and the UNFCCC is one of path dependence,[174] reciprocal legitimation, and science-policy-law co-production. The early work of the IPCC played an instrumental role in facilitating negotiations for a climate convention.[175] The First Assessment Report (FAR), which was published in 1992, furnished a scientific basis for the adoption of the UNFCCC. The then Chairman of the IPCC, Bert Bolin, notes that the IPCC and the Intergovernmental Negotiating Committee (INC), the body tasked with preparing the draft text of the UNFCCC, had an extremely close working

[173] IAC, 'Evaluation of IPCC's assessment process' (2016) < http://www.interacademycouncil.net/File.aspx?id=27675> accessed 22 February 2016.
[174] T.Meyer, n97, 35.
[175] S.Agrawala, n99, 625.

relationship.[176] The work of the INC was heavily based on the IPCC assessments and the IPCC Chairman also participated in the INC sessions.[177] The IPCC also lobbied governments and other intergovernmental organisations such as the Organisation for Economic Cooperation and Development (OECD) to enter into negotiations for a climate convention.[178] Through its extensive engagement with the INC and these other stakeholders, the IPCC played a crucial role in drumming up multilateral support for the UNFCCC.

Bolin further observes that during negotiations for a climate convention at the 1992 UN Conference on the Environment and Development (UNCED) in Rio, scientific arguments were no longer the focus of discussion, meaning that the FAR (i.e. the scientific basis of climate change) had already been embraced by the political community and was serving its purpose.[179] However, marked differences remained between states on key issues such as mitigation targets and what constituted *dangerous anthropogenic interference* with the climate system. Moreover, the long-term implications of climate change had not been comprehensively understood by 1992. These prevailing knowledge gaps provided the IPCC with a continuing raison d'être, namely an advisory role within the UNFCCC regime even after its inception – a function that it performs to this day.

The IPCC occupies an indispensable position within the UNFCCC regime. As the sole provider of expert knowledge on climate change, it is the epistemic lifeline of the international legal regime on climate change. To the extent that its assessments inform

176 B.Bolin, n2, 69.
177 Ibid, 69-70
178 Ibid.
179 Ibid, 75.

the content of the UNFCCC's outputs (i.e. by providing sound scientific bases for regulation), the IPCC is also arguably a key source of its authority and legitimacy. Similarly, by way of reciprocal legitimation, the UNFCCC, Kyoto Protocol and Paris Agreement also provide legal bases for the IPCC's authority. More specifically, the following provisions can be construed as additional legal sources of the IPCC's authority.

Article 21.2 of the UNFCCC prescribes that "the head of the interim secretariat of the Convention will cooperate with the IPCC to ensure that the latter can respond to the need for objective scientific and technical advice."[180] Article 5 of the Kyoto Protocol states that methodologies for estimating anthropogenic emissions and global warming potentials used to calculate carbon dioxide equivalence of anthropogenic emissions shall be those accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties at its third session.[181] The Paris Agreement also reaffirms the UNFCCC's reliance on the IPCC, inviting the latter to "provide a special report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas pathways."[182] The IPCC also closely collaborates with the Subsidiary Body for Scientific and Technological Advice (SBSTA), the main UNFCCC treaty body tasked with incorporating scientific and technical data into the climate change regime. The SBSTA and UNFCCC COPs have endorsed a series of IPCC methodological guidelines for the calculation of GHG inventories and treatment

[180] *United Nations Framework Convention on Climate Change* (adopted 9 May 1992, entered into force 21 March 1994) 1833 UNTS 3, Article 21.2.
[181] *Kyoto Protocol to the United Nations Framework Convention on Climate Change* 'KP' (adopted 11 December 1997, entered into force 16 February 2005) UN Doc FCCC/CP/1997/7/Add.1, Articles 5.2 & 5.3.
[182] *Paris Agreement* (adopted 12 December 2015, entered into force 4 November 2016) 78 UNTS 54113 <https://unfccc.int/sites/default/files/english_paris_agreement.pdf> accessed 3 February 2017, Article 21.

of uncertainties in emissions estimations.[183] The SBSTA also periodically makes requests to the IPCC for scientific reports and technical papers.[184] The foregoing factors indicate a relatively high level of integration between the IPCC and UNFCCC. This science-law integration has important implications for climate litigation, as it provides a direct pathway for litigants to invoke and harness IPCC assessments as persuasive epistemic tools that support and substantiate their claims, because they have already been subject to legal scrutiny and certification by the UNFCCC regime.

V. IPCC Climate Science in Litigation: Two Framings

To understand the distinctive character of climate science, this chapter has thus far analysed the IPCC's institutional character and knowledge practices and demonstrated that climate science is co-produced knowledge emerging out of the following dynamics: i) *science-policy co-production* between climate scientists, other experts, government officials and policy-makers and; ii) *science-policy-law co-production* through the interactions between the IPCC and the UNFCCC regime. This section further seeks to problematise the nature of IPCC climate science by making a case for moving away from a positivist account towards a more STS-constructivist 'science in action' understanding of it as a continually evolving, internally varied and hybridised knowledge system that is predominantly being generated and shaped by public policy, litigation and adjudication. I argue that there are two principal framings or productive ways in which IPCC climate science can be best understood: i) as an applied science and; ii) as trans-science. This bipartite framing in turn enables a micro-level analysis of

183 Farhana Yamin & Joanna Depledge, *The International Climate Change Regime: A Guide to Rules, Institutions and Procedures* (CUP 2004) 467-468.
184 Ibid, 483.

the various applications of climate science in legal and policy settings, including litigation and adjudication, by multiple transnational actors to achieve pro-regulatory outcomes as discussed in subsequent chapters.

i. An applied science

IPCC climate science bears many of the hallmarks of what scientists and philosophers of science have called *applied science*, which is science that has practical applications in the context of technological and policy design and development.[185] The IPCC has played a seminal role in the maturation of climate science into an applied science through its heavy use of GCMs, which are the main methodological tools used in the 'detection, attribution and prediction of global climate change.'[186] According to the IPCC, GCMs are 'the most advanced tools currently available for simulating the response of the global climate system to increasing greenhouse gas concentrations.'[187] They are designed and simulated to not only understand the phenomenon of climate change for its own sake, but equally to shape, direct and drive policy responses and regulatory interventions on climate change globally. In this regard, IPCC climate science (and GCM-derived data) can be considered a body of applied science because from its very inception it has been geared towards the development and design of climate change policies. Therefore, the value and utility of GCMs is predicated on their

[185] The term 'applied science' was coined by Samuel Taylor Coleridge in 1817, but concepts such as 'practical science' (*Angewandte Wissenschaft)* were also developed in parallel at approximately the same time by German scientists of a Kantian bent. By the 1850s, the term 'applied science' had become dominant and widely used in Europe. See Robert Bud, '"Applied Science": A Phrase in Search of a Meaning' (2012) 103 *Isis* 3, 537-538; 543-544.

[186] Note that General Circulation Models are also known as Global Climate Models. The terms are used interchangeably and acronymised as GCMs. William M. Goodwin, 'Global Climate Modeling as Applied Science' (2015) 46 *Journal for General Philosophy of Science* 2, 339.

[187] IPCC, 'What is a GCM?' (2018) < http://www.ipcc-data.org/guidelines/pages/gcm_guide.html> accessed 17 July 2018.

predictive accuracy and quantitative reliability primarily as a basis for policymaking and regulation.

Whether a climate change policy, including mitigation, is appropriate largely depends on what is causing the climate to change – an assessment of *attribution* which rests on the quantitative adequacy of GCMs.[188] Attribution studies involve comparative analysis of the outputs from GCMs which are operated using only natural forcings with outputs from GCMs that are run using anthropogenic forcings. If observations cannot be reproduced by GCMs using only natural forcings, but can be reproduced by those that use anthropogenic factors, then it serves as evidence that anthropogenic factors are the cause of the detected climate change.[189] GCMs are run by multiple research groups around the world and outputs from their simulations are aggregated and averaged to produce a best probabilistic estimate of how the climate will respond under a particular emissions scenario.[190] For all these reasons GCMs are generally considered the 'epistemic core of the climate science/policy community.'[191] The quantitative reliability of GCMs has often been called into question by climate skeptics who posit that results produced by climate models are unreliable because they cannot be reproduced through standard scientific experimentation. Climate skeptic attacks on GCMs are based on a fundamental misapprehension about the nature and purposive role(s) of climate science as a practical knowledge enterprise or knowledge that is specifically designed for policymaking and regulation. This brand of climate skepticism, which is politically

[188] W.M. Goodwin, n186, 340.
[189] Ibid.
[190] Ibid.
[191] Paul N. Edwards, 'Representing the global atmosphere: Computer models, data, and knowledge about climate change' in Clark A. Miller & Paul N. Edwards (eds), *Changing the Atmosphere: Expert Knowledge and Environmental Governance (Politics, Science, and the Environment* (MIT Press 2001) 64.

motivated and aimed at thwarting climate change policies differs from 'methodological convergence skepticism' – a scientific school of thought which argues that GCMs and their data outputs can never be improved to the point of producing deterministic climatic prognoses.[192]

Offering an alternative perspective on climate science as an applied science, philosophers of science such as Goodwin have opined that:

> the appropriate analogy for understanding what makes simulation results reliable in global climate modeling is *not* with scientific experimentation or measurement, but – at least in the case of the use of global climate models for policy development – with the *applications* of science in applied design problems.[193] (Emphasis added)

Goodwin observes that positive support for the reliability of GCMs can be provided by a 'relative strategy' which examines and argues for 'epistemological parallels between traditional experimentation and computer simulations.'[194] One way to do this is to treat computer simulations as experiments whereby the experimental system is a computer coded with a GCM.[195] However, the analogy between experimentation and computer simulation models is strained by the fact that GCMs are used to map and make *future* projections of the world under a changed climate. Other scholars have suggested that the outputs of climate modelling can be defended against skeptic attacks on the basis that it is a body of knowledge that is fortified, continually renewed and fine-tuned by

[192] Anna Leuschner, 'Uncertainties, Plurality, and Robustness in Climate Research and Modeling: On the Reliability of Climate Prognoses'(2015) 46 *Journal for General Philosophy of Science* 2, 369.
[193] W.M. Goodwin, n186, 343.
[194] Ibid, 343.
[195] Ibid, 344.

research pluralism. Leuschner observes that scientific plurality in climate research generates 'diverse results [that] are used to construct, evaluate and improve climate models and, consequently, help to produce a robust range of climate prognoses.'[196]

The sheer complexity of climate modelling has led science philosophers to more recently argue in favour of assessing the efficacy and reliability of GCMs by reference to their *applications* in policy design and development contexts.[197] On this constructivist reading of GCMs as primarily a *policy design tool*, the more productive enquiry (and ultimately the case for their continuing relevance and reliability) then becomes whether GCM outputs are helping to productively inform and enable policy design and regulatory interventions on climate change. Conceptualising climate science as an applied science makes it easier to comprehend as a body of knowledge that is fluid and subject to renewal and modification precisely because it is constantly responding to and being adapted in accordance with the vicissitudes of an ever-changing climate. It is therefore entirely conceivable that the *applications* of climate science are many and varied as well as constantly subject to revision in policymaking and litigation contexts as they continue to wrestle with a plethora of climatic scenarios and impacts.

ii. Trans-scientific characteristics

IPCC climate science is also a paradigmatic example of 'trans-science' as theorised by scientists and STS-constructivist scholars because it has been generated at the interface of science and other disciplines by the IPCC, which is a boundary or hybrid management organisation, as illustrated above in section III. The term was coined in 1972 by the

196 A.Leuschner, n192, 368.
197 W.M.Goodwin, n186, 344.

American nuclear physicist Alvin Weinberg to denote those 'questions [of fact] which can be asked of science and *yet which cannot be answered by science*...they transcend science.'[198] Questions of public policy, including those pertaining to climate change where issues of science and politics converge, are therefore 'trans-scientific questions' to which scientists can only ever give trans-scientific answers. Key bodies of climate science can plausibly be characterised as trans-science. More specifically, the science emerging in response to recent climate litigation, namely event attribution science, can be labelled trans-science. This body of climate science is being partly generated to help with establishing climate causation[199] – a question that is neither exclusively scientific nor legal but both, hence trans-scientific – in the courtroom, but cannot do so in a deterministic manner as evidenced by the probabilistic articulation of climate modelling data.

As Majone observes, in standard setting contexts 'regulatory judgment is as important as engineering [or scientific] judgment and as equally dependent on experience, insight and other trans-scientific elements.'[200] Thus, seen in this light, the involvement of domestic courts and other actors (litigants) in trans-scientific determinations makes sense. Litigation provides a space for transdisciplinary engagement between these actors which are all part of a *trans-scientific* enterprise in which they are called upon to make their own epistemic contributions. Trans-scientific debates such as those pertaining to climate change generally imply oscillation between these different disciplinary (i.e.

198 Alvin M. Weinberg, "Science and Trans-Science" (1972) 10 *Minerva* 2, 209, 218.
199 For example, in the appeal proceedings for *RWE v Saul Luciano Lliuya*, the Higher Regional Court of Hamm ordered the production of attribution studies that could assist with satisfying specific causation requirements at the evidentiary stage of the hearings. See Germanwatch, 'General ruling of the civil high court in Hamm' (14 November 2017) < https://germanwatch.org/en/huaraz> accessed 17 February 2020.
200 Giandomenico Majone, 'Science and Trans-science in Standard Setting' (1984) 9 *Science, Technology & Human Values* 1, 17.

science and law) boundaries. Science is inadequate on its own for dealing with climate change issues which are inherently trans-scientific in that they involve *value judgments* about how identified risks *ought* to be managed and what is worthy of regulation and legal redress – i.e. climatic harm/injuries, rights protection and the welfare of future generations (intergenerational equity) etc. In this regard, legal-adversarial processes such as litigation have assumed significance as a mechanism to address these intrinsically trans-scientific questions and sort 'good' (soundly constructed) from 'bad' (poorly constructed) climate science which is subsequently brought to bear on these issues.

Weinberg himself endorsed 'the adversary procedure as the best alternative' to address and resolve trans-scientific questions.[201] While acknowledging that legal procedure cannot establish scientific 'truths' since the outcome is always trans-scientific, Weinberg believed that it could nonetheless serve to establish where science ends and trans-science begins.[202] In short, adversarial processes such as litigation provide the preconditions for boundary work by enabling scientists to be more forthcoming about the contours and limits of their epistemic jurisdiction (i.e. engage in demarcation), which Weinberg suggests is the 'role and responsibility of the scientist in trans-scientific debate.'[203] However, STS and legal scholars have challenged the idea that legal-adversarial processes are any more conducive and appropriate than scientific processes for the resolution of trans-scientific questions. For example, Majone observes that new scientific understandings often increase rather than reduce the cognitive complexity of regulatory problems.[204] Thus, despite rapid advancements in climate science, it will

[201] A.Weinberg, n198, 216.
[202] Ibid.
[203] Ibid, 220.
[204] G.Majone, n200, 19.

always be difficult for courts and judges to address climate change questions due to their innately trans-scientific and indeterminate character. Nevertheless, a workable core of climate science now exists to assist courts as triers of fact – an issue discussed in Chapters Four and Five.

VI. Conclusion

The IPCC's knowledge practices typify boundary work and are geared towards the production of regulatory science. Its knowledge work is heterogeneous and variegated, comprising expert contributions from scientists and social scientists. Its assessment cycle is designed to concurrently secure the dual imperatives of preserving the credibility of climate science on the one hand and promoting wider political acceptance of the knowledge base on climate change on the other. The IPCC manages to navigate this core existential tension with a high level of success, particularly as evidenced by the later stages of peer review and the approval of reports, which typically culminate in consensus formation between the scientific and political communities. The production of consensus is all the more remarkable given that the political certification of IPCC reports occurs in a highly polarised environment.

The IPCC is also at the apex of transnational climate change governance. While it does not generate climate change policies or norms, its knowledge work is a significant catalyst for their creation. The work of WGII and WGIII serves as a guide to regulatory action, namely mitigation and adaptation. Closer examination of the IPCC's knowledge practices, particularly those of the more integrated WGII and WGIII, also reveal an increased contribution in recent assessment cycles from the interpretive social sciences.

This revelation contradicts some STS-constructivist accounts of the IPCC, which charge the institution with propagating a deficient conception of climate change through a predominantly technoscientific narrative. Such critiques of the IPCC's knowledge monopoly are partly understandable as they derive from legitimate concerns about epistemic hegemony and amplified technocratic power.

However, it has been argued here that while such critiques may be forceful, they ought to be regarded with caution. Although the IPCC's work is imperfect and not immune to criticism, such critiques are misguided, as they do not look closely at its actual knowledge practices. Few would deny that regulatory action on climate change must be based on sound science, which (in our collective interest) ought to retain the initial prerogative to preliminarily define and map the problem. To the extent that climate change is also a socio-economic problem, the interpretive social sciences and alternative epistemological perspectives (e.g. indigenous and local bodies of knowledge) have assumed a supporting role in the IPCC's work to address knowledge gaps in relation to vulnerability, impacts, adaptation, and mitigation. The IPCC functions remarkably well given its institutional complexity and mammoth task. Its knowledge monopoly and scientific consensus on climate change did not materialise overnight, but were hard-won through nearly three decades of intensive science-policy dialogue, debate and, institutional learning in the face of credibility crises. Its knowledge work remains an indispensable resource for transnational climate change governance.

This chapter has also sought to problematise the many misconceptions and myths about the pure nature or 'essence' of climate science. To that end, it has argued that climate science is a dynamic body of knowledge that is distinctive both for the nature of its

production (as per IPCC processes) and its evolution as a practical body of specialised knowledge that is directly tailored towards the demands and contingencies of legal processes and policymaking. IPCC climate science therefore merits the labels of applied science and trans-science. Indeed, current climate litigation trends as well as the emergence of the category of the 'scientist advocate' – activist climate scientists who appear as expert witnesses and repeat players in litigation – lend some credence to this characterisation. They are also emblematic of the increased blurring of disciplinary boundaries in the sphere of transnational climate governance. Chapters Four to Six document climate science in action, namely by focusing on its practical applications within climate governance networks and climate litigation. These chapters specifically consider how climate science is being translated and certified by domestic courts (i.e. Chapters Four and Five) and mobilised by ENGO litigants in support of their climate justice and rights-based claims (i.e. Chapter Six).

CHAPTER FOUR

Climate Science in US Federal Courts

Facts. Evidence. Reason. Logic. An understanding of science. These are good things. These are qualities you want in people making policy. These are qualities you want to continue to cultivate in yourselves as citizens.

President Barack Obama, Commencement Speech at Rutgers University, May 2016

I. Introduction

In this PhD project, I argue that climate science is being generated through transdisciplinary co-production between the domains of science, policy and law and the key actors steering this process include climate scientists, domestic courts and climate litigants. The byproduct of these co-productive dynamics is an emergent transnational and shared body of legal practice and jurisprudence on climate change, as illustrated in Chapters Five and Six. This chapter specifically examines the treatment of climate science by certain federal courts in climate change lawsuits in the United States - a subject that remains under-researched in the climate litigation literature.[1] US federal courts merit separate and specialised treatment by way of an entire chapter not only due to the high concentration of climate litigation in the US, but also because some of the earliest and most substantial judicial discussions of climate science feature in US cases. These cases are relatively high-profile because they have a pioneering transnational influence; they were among the first to feature IPCC assessments and have therefore reverberated globally and markedly influenced the judicial consideration of climate science in other jurisdictions, as discussed in Chapter Five.

[1] There are only two short articles on the topic. See Michael Gerrard, 'Court Rulings Accept Climate Science' (2013) 250 *New York Law Journal* 52; Sabrina McCormick et al., 'Science in litigation, the third branch of U.S. climate policy' (2017) 357 *Science* 3655.

I argue that certain US federal courts constitute prominent sites for the transdisciplinary co-production of climate science, with judges sometimes directly interacting with climate scientists and repeatedly evaluating and certifying IPCC assessments in climate change lawsuits over the last two decades. This is largely emblematic of a *science-law co-production* model. While most cases exemplify this model of co-production, occasionally there have been landmark cases like *Massachusetts v EPA*, which have had had a more resonant and influential impact on public policy with respect to climate change. Such cases, though rare, are reflective of *science-policy-law co-production*. Both kinds are discussed in this chapter. Although US courts are not consciously engaging in a transnational project of legal ordering through the development of climate jurisprudence, this chapter will argue that their appraisal of climate science is nonetheless taken seriously by courts and communities of legal practice in other jurisdictions. Thus, US climate litigation can be considered a key contributor to the transnationalisation of scientifically-inflected climate change jurisprudence.

The US is where most public and private climate litigation is taking place, with lawsuits growing exponentially.[2] As a metropolitan site of knowledge production, the US is also where many of the world's leading climate scientists and contributors to the IPCC assessment cycle are based. Many of them have participated in high profile US climate change lawsuits as defendants, plaintiffs, and court-appointed experts.[3] Similarly, many

[2] Hari M. Osofsky & Jacqueline Peel, *Climate Change Litigation: Regulatory Pathways to Cleaner Energy* (CUP 2015); Sabin Center for Climate Change Law (Columbia Law School), 'Climate Change Litigation Databases: U.S. Climate Change Litigation' (2017) <http://climatecasechart.com/us-climate-change-litigation/> accessed 20 October 2017.

[3] For example, *Green Mountain Chrysler Plymouth v Crombie*, 508 F. Supp. 2d 295 (D. Vt. 2007) and *Kelsey Cascadia Rose Juliana et al. v. United States of America et al* (2016) Case No. 6:15-cv-01517-TC, 4.

of the world's largest fossil fuel corporations, which are typically defendants in climate change lawsuits and increasingly referred to as Carbon Major Entities (CMEs),[4] are also headquartered or have operations in the US. To date, climate advocates have used litigation to challenge government inaction on climate change and as an alternative regulatory pathway to compel corporate emitters to reduce their GHG emissions.[5] Climate change litigation has therefore become both a catalyst for regulation and itself a new form of regulation.[6]

The dismantling of US environmental and climate change regulations under the Trump Administration is likely to spur even more climate litigation.[7] Against this backdrop, the acceptance and endorsement of climate science, particularly IPCC assessments, by certain US courts, including the Supreme Court, is highly noteworthy and merits close attention. The judiciary has already played a major role in influencing and compelling US government agencies to adopt climate-friendly regulations in the past.[8] Based on an analysis of case law, I argue that some US courts have been largely deferential towards climate scientists and accepted and affirmed the underlying climate science in many major climate change cases in the last two decades.

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4 Richard Heede, 'Tracing Anthropogenic Carbon Dioxide and Methane Emissions to Fossil Fuel and Cement Producers, 1854–2010,' (2014) 122 Climatic Change 1, 229.

5 H.M.Osofsky & J.Peel, n2

6 Jacqueline Peel & Hari M.Osofsky , 'Climate Change Litigation's Regulatory Pathways: A Comparative Analysis of the United States and Australia,' (2013) 35 *Law & Policy* 3; H.M. Osofsky & J. Peel, n2.

7 Coral Davenport, 'Trump lays plans to reverse Obama's climate change legacy' *New York Times* (21 March 2017) <https://www.nytimes.com/2017/03/21/climate/trump-climate-change.html> accessed 21 March 2017; Martin Pengelly, 'Trump to sign executive order undoing Obama's clean power plan' *The Guardian* (26 March 2017) <https://www.theguardian.com/environment/2017/mar/26/trump-executive-order-clean-power-plan-coal-plants> accessed 26 March 2017; David Smith, 'Trump begins tearing up Obama's years of progress on tackling climate change' *The Guardian* (28 March 2017) < https://www.theguardian.com/us-news/2017/mar/28/trump-begins-tearing-up-obamas-years-of-progress-on-tackling-climate-change> accessed 28 March 2017.

8 See *Massachusetts v EPA* 127 S. Ct. 1438; 549 U.S. 497 (2007); *Green Mountain Chrysler Plymouth v Crombie*, 508 F. Supp. 2d 295 (D. Vt. 2007).

Furthermore, the IPCC indirectly features as an actor in any climate litigation scenario in which causation is an issue, due to its position as the pre-eminent synthesizer and supplier of climate science. Its global monopoly on the certification of climate science has led to its assumption of (an as yet unacknowledged) *de facto* specialist jurisdiction or an adjudicatory fact-finding role in climate change cases. This also sets climate science and climate change litigation and adjudication apart from other types of environmental litigation involving scientific evidence. Critically, the IPCC's expanded pre-adjudicatory role partly accounts for the reluctance of some US courts to engage in judicial fact-finding in climate change cases, the outcomes of which are heavily contingent on scientific determinations on causation. Courts have already begun to acknowledge the IPCC's dominance in this area and have generally limited their role to: i) traditional judicial review of the lawfulness of the conduct of government agencies (strategic public litigation); and, ii) deferring to government agencies to regulate the industrial activities of carbon producers and their GHG emissions (strategic private litigation).[9]

However, in this chapter I also contend that the IPCC's dominance as a fact-finder on climate change does not entirely obviate the need for judicial fact-finding in climate litigation. It is argued that through their repeated affirmation and acceptance of general scientific-causal evidence on climate change, national courts have become principal actors in the legal certification of IPCC climate science and important interlocutors in transnational climate change governance. Furthermore, in recent climate litigation (albeit predominantly public litigation), courts have not always shied away from

[9] See *People of the State of California* v *General Motors Corp*, No. C06-05755, (N.D. Cal., 09/17/2007); *American Electrical Power Co. (AEP)* v *Connecticut* 564 U.S. 410 (2011); *Kivalina* v *ExxonMobil Corporation et al.* 696 F.3d 849, 2012 WL 4215921 (9th Cir. 2012); *Comer* v *Murphy Oil USA Inc.*, 607 F.3d 1049 (5th Cir. 2010).

independent fact-finding and have actively participated in constructing the factual record of a case through an initial review and appraisal of expert testimonies submitted by climate scientists in relation to extreme climatic events which are characterised by greater scientific-causal uncertainty. In sum, the fact-finding role of courts has been modified and narrowed rather than completely dispensed with in climate change cases and continues to be exercised with respect to proximate or specific causation issues. More recent climate litigation foregrounds the existence of this co-productive relationship between courts and climate scientists.

The next part of this chapter looks at the approach specifically taken by some US federal courts with respect to climate science as expert testimony in litigation, with a focus on the Supreme Court's seminal jurisprudence in *Massachusetts v EPA*. It outlines the traditional fact-finding role of US federal courts and documents how climate adjudication marks a slight departure from this role, since courts are actively transforming scientific facts on climate change into justiciable facts. Part III examines judicial attempts to wrestle with the complexity of climate change causation and outlines judicial approaches to general and specific causation. Part IV examines two recent high profile judgments the *City of Oakland v BP p.l.c.* and *Juliana et al v USA*, to demonstrate that the legacy of *Massachusetts v EPA* remains alive and well in post-Paris US climate litigation, with certain district courts exhibiting even higher levels of receptiveness towards IPCC assessments and climate science. These cases have also been specifically chosen for their formative significance in relation to an emergent transnational climate change jurisprudence as discussed in Chapters Five and Six. Part V presents concluding observations.

II. The Climate Jurisprudence of the US Supreme Court

Climate litigation and adjudication have emerged and grown in response to institutional failures to effectively regulate climate change. A major strand of legal scholarship on climate change litigation therefore examines the role of litigation as an alternative regulatory pathway in light of institutional failures by international and national bodies.[10] More recent legal scholarship considers how "litigation [serves] as a forum for co-producing a physical and social understanding of climate change," and the ways in which adjudication authorises and legitimates conduct in relation to climate change.[11] Jasanoff describes litigation as a site of co-production comprising both "fact-finding and meaning-making."[12]

The discussion here is situated in line with this latter scholarly oeuvre. An STS-inflected lens is employed to understand and analyse the relationship between courts and the IPCC as one of co-production of climate change as a concurrently socio-political, legal, and scientific reality. In order to contextualise the role that courts are playing in the co-production of facts about climate change, this section will first outline the traditional fact-finding role of American federal courts in cases marked by scientific complexity. The discussion will then specifically concentrate on the important role that courts play in constructing and legitimating a particular scientific-epistemic and socio-legal worldview of climate change, namely that of the IPCC. The US' unique position as a

[10] See H.Osofsky & J.Peel, n2; Joana Setzer & Lisa C. Vanhala, 'Climate change litigation: A review of research on courts and litigants in climate governance' (2019) 10 *Wiley Interdisciplinary Reviews: Climate Change* 3.
[11] Elizabeth Fisher, 'Climate Change Litigation, Obsession, and Expertise: Reflecting on the Scholarly Response to Massachusetts v EPA' (2013) 35 *Law & Policy* 3, 237.
[12] Sheila Jasanoff, 'A New Climate for Society' (2010) 27 *Theory, Culture & Society* 233, 248.

metropolitan site of knowledge production (including in the field of climate science), and its status as one of the most significant contributors to climate change both in terms of size and per capita emissions, accounts for the conscious choice here of the US as the primary jurisdiction and object of study in this chapter. Given the high volume of US climate litigation, the discussion will be limited to climate change cases adjudicated by federal courts, which best reflect the current state of the common law and statutory regimes on climate change.

Judicial fact-finding and evaluation of scientific evidence

In the US, District Courts are federal trial courts which are designed for fact-finding and the construction of a case's factual record based on scientific and expert evidence presented by the parties.[13] Federal appellate courts are empowered to amend errors in the factual record created at trial and establish standards of proof.[14] In administrative law cases, federal courts are also empowered to review 'jurisdictional facts' which comprise a statutorily prescribed set of facts or circumstances that must exist before a government official or agency can legitimately exercise authority.[15] The Supreme Court has also extended this doctrine beyond the administrative context.[16] In general, American courts abide by the principle of deference with respect to legislative fact-finding.[17] Both commentators and courts have argued that legislatures possess superior

[13] Noel Leon, 'Judicial Fact-Finding Isn't Just Legitimate, It's Crucial' *Rewire* (5 August 2016) < https://rewire.news/article/2016/08/05/judicial-fact-finding-legitimate-its-crucial/> accessed 6 April 2017.
[14] Joseph T. Walsh, 'The Evolving Standards of Admissibility of Scientific Evidence' (1998) 2 *Best of ABA Sections* 1, 3.
[15] George C. Christie, 'Judicial Review of Findings of Fact' (1992) 87 *Northwestern University Law Review* 1, 20; See *Crowell v Benson* 285 U.S. 22 (1932) where Hughes CJ ruled that courts determine not only questions of law, but also certain 'fundamental or jurisdictional' facts.
[16] Ibid; See *Bose Corp. v Consumers Union of the United States* 466 U.S. 485 (1984).
[17] Caitlin E. Borgmann, 'Rethinking Judicial Deference to Legislative Fact-Finding' (2009) 84 *Indiana Law Journal* 1, 6.

competence with respect to fact-finding as compared with courts due to greater resources at their disposal and the capacity to aggregate expert knowledge from multiple sources to create a comprehensive factual record on an issue.[18]

However, Borgmann argues that existing case law largely demonstrates that the 'doctrine of judicial deference to legislative fact-finding' is in disarray.[19] For example, the US Supreme Court has not clearly articulated the role that facts should play in its constitutional decisions.[20] Borgmann further questions the wisdom of applying judicial deference to legislative fact-finding in a blanket manner, since legislatures can also be poor fact-finders when compared to federal trial courts, especially when dealing with legislation that infringes constitutional or minority rights.[21] Some constitutional rights cases on abortion, gay parenting and child protection from internet indecency have revealed that legislatures did not undertake comprehensive fact-finding, but based their policy decisions on assumptions and hearsay.[22] For example, Congressional hearings on abortion have often been far more protracted than trials on the same issue and involved inflammatory, non-medical testimony and invective from lay witnesses. Some legal commentators have accordingly emphasised the importance of courts exercising independent judgment on factual questions in each case before them and, where necessary, striking down findings of fact that appear unreasonable.[23]

Furthermore, with respect to scenarios involving scientific complexity, the legislature does not necessarily possess superior fact-finding competence relative to federal trial

[18] C.E.Borgmann, n17, 18.
[19] Ibid.
[20] Ibid.
[21] Ibid, 21.
[22] For an extended discussion on this topic see C.E.Borgmann, n17.
[23] Ibid; G.Christie, n15, 26.

courts. When legislative findings of fact go against the overwhelming weight of scientific or expert evidence on an issue, trial judges are duty-bound to act as gatekeepers and independent evaluators of that evidence and scrutinise scientific-expert testimony for credibility and legitimacy. This was the test set out by the Supreme Court majority with respect to the evaluation and admissibility of scientific evidence by federal courts in the landmark 1993 case of *Daubert v Merrell Dow Pharmaceutical Inc.* In *Daubert*, the Supreme Court ruled that in dealing with scientific evidence, a trial judge must serve as a "gatekeeper [to] ensure that the expert testimony both rests on a *reliable foundation* and is *relevant* to the task at hand."[24] In performing this duty, the trial judge has recourse to multiple sources including expert testimonies. The court also concluded that trial judges retain considerable discretion with respect to the admissibility of scientific evidence, namely whether such evidence passes the test of reliability. However, in exercising such discretion to determine the admissibility of scientific evidence, the Supreme Court established criteria pertaining to scientific method that a trial judge must consider in every instance. These include the following: i) whether the theory or technique can be tested; ii) whether the submitted evidence or expert testimony has been subject to peer review; iii) whether the margins of error are acceptable, and; iv) whether the method at issue enjoys widespread acceptance within the scientific community to which the expert belongs.[25]

In essence, the *Daubert* ruling provides a mechanism for federal judges to exclude vast bodies of junk science by determining what is admissible as relevant and reliable expert evidence or 'good science.' The decision was widely interpreted as requiring judges to

[24] *Daubert v Merrell Dow Pharmaceutical, Inc.* 509 U.S. 579 (1993).
[25] Ibid.

adopt a scientific frame of mind and bring the legal assessment of science into closer alignment with scientific assessment methods.[26] This move has not been without controversy or criticism. Delivering a persuasive critique of the *Daubert* decision, Jasanoff has argued that the attempt to make judicial practice more scientific is consistent with the neoliberal impetus within economics and law and constitutes "part of a tectonic shift in US legal and political thought which aims to "modernize" legal decision-making by making it more standardized, efficient, and predictable."[27] The scientisation of legal admissibility criteria for scientific evidence does not necessarily guarantee the delivery of justice and, in many cases, impedes it.[28] Notably, *Daubert* has been routinely invoked to exclude plaintiffs' testimony and created a more favourable legal environment for defendants.[29] Jasanoff further argues that mechanical judicial applications of *Daubert* criteria in practice, underlined by a preoccupation with good science, have sometimes oriented law away from its foundational imperative of doing justice.[30] By privileging a rational basis for making normative judgements, Jasanoff asserts that *Daubert* "detached science from its human and social context and drove a wedge between reason and justice."[31]

Such STS scholarly concerns about the scientisation of legal admissibility criteria pertaining to scientific evidence are not necessarily valid in all cases where federal courts have considered scientific evidence. Rather, more recent judicial practice indicates that courts have not always lost sight of ethical and justice imperatives when

[26] Sheila Jasanoff, 'Law's Knowledge: Science for Justice in Legal Settings' (2005) 95 *American Journal of Public Health* 1, 50.
[27] Ibid.
[28] Ibid.
[29] Ibid.
[30] Ibid, 57.
[31] Ibid.

engaging in fact-finding and evaluating scientific evidence. More specifically, federal courts play an important supplementary fact-finding role in situations where legislative fact-finding is found to be deficient or lacking. This is best illustrated by recent abortion cases, which evidence that the judicial assessment of science is, on this particular issue, firmly wedded to its relevant human and social context of safeguarding women's health and reproductive rights.[32] While American courts do not have an exclusive remit to evaluate scientific evidence, they nonetheless retain a review function to ensure that the factual record in a case is sound, credible, and based on actual peer-reviewed scientific evidence rather than junk science. Federal abortion cases exemplify a judicial directive to lawmakers that scientifically unsubstantiated laws that infringe on constitutional rights are at high risk of being overturned.[33]

Scientific and legal paradigms also differ with respect to their conception of a 'fact' or 'truth.' Legal proceedings are often characterised by tensions and divergences between "formal legal truth and substantive truth in judicial fact-finding processes."[34] Both lawyers and judges are cognisant of the reality that litigation and adjudication, while generally truth-oriented, do not always produce a factual record that perfectly corresponds to empirical, scientific, or social facts.[35] As legal scholars like Summers assert, "it is simply not so that the exclusive business of a trial court in all disputed cases is to find the *actual* truth."[36] The particular circumstances and factors of a case that may

[32] See Justice Breyer's judgment in *Whole Woman's Health v Hellerstedt* 579 U.S. No.15-274 (2016).
[33] Noel Leon, 'Judicial Fact-Finding Isn't Just Legitimate, It's Crucial,' *Rewire* (5 August 2016) < https://rewire.news/article/2016/08/05/judicial-fact-finding-legitimate-its-crucial/> accessed 6 April 2017. This is of course subject to the important caveat that under the current Trump Administration, the composition of the Supreme Court may change. This leaves open the possibility for *Roe v Wade* to be overturned under a more conservative bench.
[34] Robert S. Summers, 'Formal Legal Truth and Substantive Truth in Judicial Fact-Finding – Their Justified Divergence in Some Particular Cases' (1998) 18 *Law & Philosophy* 1, 497.
[35] Ibid, 497.
[36] Ibid, 500.

produce this discrepancy include *inter alia* the unavailability of evidence, unequal legal representation of parties before the court, inequality in resources for trial preparation between the parties, prejudice or bias on the part of fact-finders, and the incompetence of fact-finders in understanding and weighing evidence.[37]

In addition, legal rules of procedure and evidence are geared towards the production of formal findings of fact which may depart from substantive truth.[38] Similarly, lawyer-client privilege also limits the admissibility of evidence that may reflect substantive truth such as a defendant's confession about committing a crime. Consequently, the factual record created at trial and the substantive truth or reality of a case rarely align. While these procedural and evidentiary rules are not consciously truth-defeating, they are designed to serve other policy imperatives such as protecting the client-lawyer relationship and the representative role of lawyers in general, render trials more time-efficient, and facilitate the final resolution of legal disputes. Thus, legal rules of evidence and procedure structurally privilege legal truth (i.e. formal legal findings of fact) over substantive social truth. In short, "there are limits to the law and the fact-finding efficacy of law's machinery."[39]

Finally, legal processes of factual enquiry and the creation of a factual record at trial are heavily circumscribed by legal standards of proof.[40] In a civil trial, factual enquiries need only be pursued up to the point where the balance of probabilities (i.e. a much lower threshold than the criminal law standard of beyond reasonable doubt) can be satisfied. For example, rules of evidence typically dictate that only those facts which are

[37] R.S.Summers, n34, 499.
[38] Ibid, 500.
[39] Ibid, 505.
[40] Ibid, 506.

relevant to and potentially probative of a cause of action are admissible. This can lead to the exclusion of a plethora of substantive (albeit less relevant) facts that might nonetheless provide a more complete picture or reveal the 'actual' truth of the case. Formal findings of fact are therefore the culmination of processes of factual enquiry that are artificially tailored and curtailed to meet legal rather than scientific or social-scientific standards of proof.

In sum, legal processes of fact-finding generally and judicial fact-finding specifically are not predicated on a scientific understanding of facts, despite the recent scientisation of admissibility criteria for scientific evidence in litigation following *Daubert*. Rather, they are deeply inscribed with non-scientific imperatives, namely concerns about the ethics, responsibility, justice, and temporal efficacy of a particular case. Thus, adjudication is not a search for substantive truth, but rather a process geared towards a number of objectives including righting past wrongs, achieving a final resolution on a case and thereby producing definitive winners and losers. While formal legal facts and the substantive truth in a particular case may sometimes coalesce, in many cases they also diverge. The pursuit of substantive truth is therefore only one among many competing values and imperatives of litigation and adjudication in the American legal system.

Applying these observations to the climate change context, I argue that judicial fact-finding in climate change cases extends beyond the simple acceptance and certification of climate science in accordance with the *Daubert* principles, which purportedly reflect core precepts of the scientific method. Rather, it is conceivable that judicial fact-finding in climate change cases is and will always continue to be motivated and driven by extra-

scientific considerations, including legal-procedural efficacy, the provision of stability and certainty in judicial decision-making, and a final resolution. Courts are therefore not only making findings of fact, but concurrently transforming those facts into what Latour has termed "matters of fact."[41] Consequently, the gatekeeping role of US federal courts with respect to scientific evidence is also indispensable in climate change cases. In collaboration with other actors in climate litigation, courts are playing a crucial role in transforming scientifically documented factual scenarios of climatic harm into actionable wrongs that merit legal resolution and the production of a just outcome – an issue that is explored in greater detail in the following section.

The certification of climate science in *Massachusetts v EPA*

Massachusetts v EPA is the first landmark environmental case in the US where the Supreme Court directly addressed climate change as well as the science of the problem. The case earned this reputation as a watershed in climate litigation, as it marked the first time an American court ruled that GHGs "unambiguously may be regulated as an 'air pollutant'" by the Environmental Protection Agency (EPA) under section 202 of the Clean Air Act (CAA).[42] Hailed by legal scholars as the most "significant environmental decision of our time," the case has unsurprisingly been the subject of extensive scholarly interest and analysis.[43] A comprehensive engagement with the legal literature on *Massachusetts v EPA* is beyond the scope of this examination, which focuses specifically on the American federal judiciary's treatment of climate science. This

[41] See Bruno Latour, 'Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern' (2004) 30 *Critical Inquiry* 225. Latour makes a call to renew empiricism by cultivating a 'stubbornly realist attitude.'

[42] *Massachusetts v Environmental Protection Agency* 127 S. Ct. 1438; 549 U.S. 497 (2007) 529.

[43] Elizabeth Fisher, 'Climate Change Litigation, Obsession and Expertise: Reflecting on the Scholarly Response to *Massachusetts v EPA*' (2013) 35 *Law & Policy* 3, 244; David Markell & J.B. Ruhl, 'An Empirical Assessment of Climate Change in the Courts: A New Jurisprudence or Business as Usual?' (2012) 64 *Florida Law Review* 15, 76.

section will however draw on this literature to provide a brief overview of the surrounding socio-political context that informed and led to the decision, particularly as it relates to the state of climate science at the time.

Massachusetts v EPA is also salient for being the first climate change lawsuit in which the Supreme Court declared American municipal courts as appropriate fora for the adjudication of climate change matters and, by implication, for the review of climate science underlying litigants' claims. Remarking on the peculiar difficulties of climate change adjudication, Osofsky observes that "the complexities of scale and scientific uncertainties in relation to subnational contributions to climate change place judges in a difficult decision-making position."[44] She argues that such uncertainties around scale and science create additional judicial discretion and opportunities for litigants to manipulate the outcome.[45] Judicial commentary on the issue of standing in *Massachusetts v EPA* elucidates the ways in which American federal courts are grappling with scalar and scientific complexities surrounding climate change. This section will argue that *Massachusetts v EPA* also has special *epistemic* significance due to the Supreme Court's overwhelming acceptance and endorsement of IPCC climate science. While the certification of IPCC assessments is not primarily contingent on national and subnational litigation and adjudication (as shown in Chapter Two), such legal processes have nonetheless imbued the IPCC assessments with an added layer of legitimacy. They have also served to augment the IPCC's epistemic authority overall as well as its position as a pivotal actor in global climate change governance.

[44] Hari M. Osofsky, 'The Intersection of Scale, Science, and Law in Massachusetts v. EPA,' (2007) 101 *Proceedings of the Annual Meeting (American Society of International Law)* 62.
[45] Ibid.

i. The case in its wider socio-political context

Massachusetts v EPA was the culmination of decades-long epistemic struggle on climate change – one that had been decisively settled by the global climate science community before the case's resolution in April 2007.[46] The Bush Administration was still in power in the US with a palpably anti-climate agenda, which it operationalised through the passage of numerous executive orders that adversely impacted upon the work of expert agencies like the EPA and government climate scientists. One of the most notorious examples is Executive Order 13422[47] which the Congressional Research Service interpreted as "a clear expansion of presidential authority over rulemaking agencies."[48] Legal scholars and commentators also opined that it amounted to an executive power grab that enabled White House staff to override agency scientists and experts.[49] These statements reflect the prevailing political mood at the time which was one of intense concern about the politicisation of expertise with respect to the environment, health and safety. Thus, as Freeman and Vermeule plausibly assert:

> Even if the Supreme Court Justices were unaware of the particulars of President Bush's executive orders, by the time Massachusetts v EPA reached the court, the general picture of which they are a part, including allegations of political interference with climate-related science, had clearly taken shape and concerns about politicization were widely known.[50]

[46] The IPCC published its Fourth Assessment Report in 2007. The Summary for Policymakers was published in February 2007, meaning that AR4's key findings were already widely known before the Supreme Court handed down its decision in *Massachusetts v EPA* two months later in April 2007.
[47] Exec Order 13422, 72 Fed Reg 2703 (2007) - "Each agency shall identify in writing the specific market failure (such as externalities, market power, lack of information) or other specific problem that it intends to address (including, where applicable, the failures of public institutions) that warrant new agency action, as well as assess the significance of that problem, to enable assessment of whether any new regulation is warranted."
[48] Curtis W. Copeland, 'Changes to the OMB Regulatory Review Process by Executive Order 13422 14' (Congressional Research Service, February 2007) <http://www.fas.org/sgp/crs/misc/RL3 3862.pdf.> accessed 15 April 2017; Jody Freeman & Adrian Vermeule, 'Massachusetts v EPA: From Politics to Expertise' (2007) *Supreme Court Review* 51, 59-60;
[49] J.Freeman et al, Ibid, 60.
[50] J.Freeman et al, Ibid; See Robert Pear, 'Bush Directive Increases Sway on Regulation,' *New York Times* (30 June 2007) <

Moreover, it is highly likely that the Supreme Court Justices were also apprised of the fact that the scientific consensus on climate change had been consolidated by this time and the climate crisis had captured and achieved a stranglehold on the public imagination. Two further developments also definitively shaped this broader socio-political context, namely the IPCC's publication of its Fourth Assessment Report in early 2007 and the release of former Vice President Al Gore's documentary film, an Inconvenient Truth. In addition, not only climate scientists, but the scientific community at large had become fiercely vocal in its demands for regulating the problem. These factors made up the wider "[socio-political], legal, and cultural context in which the Supreme Court decided Massachusetts v EPA."[51] Regardless of their personal views or politics, Supreme Court Justices were likely aware of the growing scientific consensus on climate change and the mounting accusations that the Bush Administration was engaging in a sustained campaign of manipulation and suppression of agency science.[52] These circumstances provided the impetus for public climate litigation in the US and were arguably the key drivers of a new wave of climate change lawsuits against regulatory agencies, of which *Massachusetts v EPA* is the first (and probably the most salient) of many examples.

ii. The Supreme Court's review of climate science

https://www.nytimes.com/2007/01/30/washington/30rules.html?mtrref=www.google.com&gwh=47E18626C045DD7EE8B364C919B0D2E5&gwt=pay&assetType=REGIWALL> accessed 28 October 2017.

[51] J.Freeman et al, n48, 61.

[52] Ibid.

Massachusetts v EPA revolved around the EPA's denial in 2003 of a rule-making petition filed in 1999 by 20 private organisations requesting the EPA to regulate GHGs from new motor-vehicles under section 202 of the CAA. The EPA concluded that it did not have the authority to issue mandatory regulations to address global climate change, since, despite being aware of the climate crisis, Congress had declined to adopt an amendment to the CAA prescribing binding emissions reductions.[53] In sum, until Congress unequivocally and specifically declared that the EPA should regulate climate change pursuant to the CAA, the EPA concluded that it was not authorised to address the issue and, consequently, that GHGs did not constitute 'air pollutants' within the meaning of the CAA.[54]

The EPA's denial of the rule-making petition was challenged by twelve states (led by Massachusetts), three cities, a US territory and thirteen NGOs.[55] The respondents comprised the EPA, ten other states, and nineteen industry and utility groups which organised themselves into three major coalitions, namely the Vehicle Intervenor Coalition, the CO2 Litigation Group, and the Utility Air Regulatory Group.[56] Neither the petitioners nor respondents challenged the existence of anthropogenic climate change. The EPA agreed with the petitioners that GHGs had increased as a result of human activities and acknowledged that there had been a rise in global temperatures. However, it argued that a causal link between the former and the latter could not be unequivocally established.

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53 *Massachusetts v EPA* 127 S. Ct. 1438 (2007); At 52926.
54 Ibid.
55 Ibid.
56 H.M.Osofsky, n44, 581. The question of statutory construction was whether GHG emissions from motor-vehicles constituted 'air pollutants' within the meaning of the CAA thereby mandating EPA regulation.

In the majority opinion delivered by Justice Stevens, the Supreme Court observed with respect to its own jurisdiction that the issue of a non-justiciable political question did not arise in this case, since the question before it was one of statutory construction and therefore suitable for review.[57] The court also rejected the EPA's arguments that standing presented an insurmountable obstacle to review. It ruled that it was perfectly within the petitioners' procedural rights to challenge agency action that is injurious to it.[58] Massachusetts was found to have special standing as a sovereign state and entitlements to protection from the federal government. The court accordingly held that it was entitled to 'special solicitude.'[59] It further ruled that the EPA's omission to regulate GHG emissions presented both an actual and imminent risk of harm to Massachusetts and any grant of judicial relief would require the EPA to reduce that risk.[60]

The majority then turned to the first standing requirement for the petitioners to show that they had suffered an *injury* and considered climate science at some length, particularly with respect to sea-level rise. It reviewed evidence of sea-level rise presented by Massachusetts in support of its claim that it was beginning to lose coastal land – the particularised injury alleged in this instance. With respect to Massachusetts' alleged injuries, the court relied upon and emphasised relevant parts of an affidavit provided by climate scientist Michael McCracken and noted the following:

> That these climate change risks are widely shared does not minimize Massachusetts' interest in the outcome of this litigation…According to the petitioners' unchallenged affidavits, global sea-level rose somewhere between 10 and 20 centimeters over the 20th century (McCracken Decl. 5(c) Stdg. App. 208). These rising seas have already begun to

[57] *Massachusetts v EPA*, n53, 13.
[58] Ibid, 15-16.
[59] Ibid, 17.
[60] Ibid, 18.

> swallow Massachusetts' coastal land…[Massachusetts] has alleged a particularized injury as a landowner. The severity of that injury will only increase over the course of the next century.[61]

With respect to the second standing requirement of causation, the EPA did not dispute the existence of a causal link between human activities and climate change, but held that its decision to not regulate GHG emissions from new motor-vehicles could not be causally linked to the petitioners' particular injuries.[62] The court rejected the EPA's contention that reducing motor-vehicle emissions would be a tentative or incremental step on the basis of its review and acceptance of McCracken's expert testimony stating that US motor-vehicle emissions account for 6% of global carbon-dioxide emissions.[63] The court accordingly held that US motor-vehicle emissions make a meaningful contribution to global GHG emissions and global warming.[64]

Finally, for the third standing requirement of redressability, the court held that a reduction in domestic emissions would slow the pace of global emissions, regardless of what happens elsewhere.[65] It afforded significant weight to the agreement between the EPA and the President to address the issue of global climate change. In relation to climate science, the court accepted the plaintiffs' affidavits providing evidence of sea-level rise as uncontested, and therefore, constitutive of the case's factual record as well as sufficiently probative of the petitioners' risk of harm.[66] The court observed the following:

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61 *Massachusetts v EPA*, n53, 18-19.
62 Ibid, 20.
63 Ibid, 21.
64 Ibid.
65 Ibid, 22.
66 Ibid, 23.

> In sum – at least according to the petitioners' uncontested affidavits – the rise in sea levels associated with global warming has already harmed and will continue to harm Massachusetts. The risk of catastrophic harm, though remote, is nevertheless real.[67]

The court concluded that this risk could be reduced by the EPA's regulatory actions (i.e. if Massachusetts were granted the relief it sought) and that the petitioners therefore had standing.[68] Ultimately, the nature of climate change as a global problem was held not to be a barrier to such adjudication, since even if the problem is shared, Massachusetts and the other co-petitioners had a legitimate stake or interest worth protecting.

On the merits, the case mainly revolved around questions of statutory construction, namely whether section 202(a)(1) of the CAA authorises the EPA to regulate GHG emissions from motor-vehicles in the event that they contribute to climate change.[69] The court concluded that the EPA did have such power. More specifically, the language of the statute was unambiguous and permitted a reading or classification of GHG emissions as an 'air pollutant,' the definition of which is capacious.[70] Evincing its affirmation of the state of climate science at the time, the court held that prevailing scientific uncertainty was not an adequate basis that precluded the EPA from issuing an endangerment finding on GHGs and regulating climate change.[71] The court therefore held that the EPA had acted "arbitrarily, capriciously… and unlawfully" by failing to offer a reasoned explanation for its refusal to regulate GHG emissions from new motor-vehicles under the CAA.[72] By implication, the court arguably chastised the EPA for not

[67] *Massachusetts v EPA*, n53, 23.
[68] Ibid, 23.
[69] Ibid, 25.
[70] Ibid, 26.
[71] Ibid.
[72] Ibid, 32.

anchoring its decision to refrain from making an endangerment finding on GHGs based on a genuine and reasonable consideration of available, state-of-the-art scientific evidence, (including IPCC assessment reports)[73] which revealed clear causal links between GHG emissions from motor-vehicles and climate change. Jasanoff observes that by ruling in this manner, the Supreme Court was, in effect, overriding climate-skeptic efforts to obstruct the regulation of GHGs by declaring that the EPA's defiance of the international scientific consensus on climate change without explanation was irrational.[74]

Although the court did not explicitly mention climate science in its discussion on the merits, in an earlier part of its judgment, the majority considered the socio-political context surrounding the development of American climate change research since the 1970s and the history of climate change regulation in the US.[75] It also acknowledged the IPCC's crucial role in advancing the scientific understanding of climate change in the early 1990s and the international community's subsequent adoption of the UNFCCC. The majority's discussion of these issues reveals a more sophisticated understanding and awareness of climate change as a multiscalar issue and a subject of regulatory concern for domestic, supranational, and international institutions. In recognising the relationship between unabated domestic GHG emissions and climate change as a global problem, the US Supreme Court also implicitly acknowledged its own role as a transnational actor called upon to adjudicate matters that touch on foreign affairs or have transboundary dimensions.

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[73] *Massachusetts v EPA*, n53, 5-6.
[74] Sheila Jasanoff, 'Cosmopolitan Knowledge: Climate Science and Global Civic Epistemology' in John S.Dryzek, Richard B.Norgaard & David Schlosberg (eds), *The Oxford Handbook of Climate Change and Society* (OUP 2011) 135.
[75] *Massachusetts v EPA*, n53, 5-6.

The court's discussion, which makes several references to advances in climate science and the corresponding development and consolidation of the international legal regime on climate change (i.e. the UNFCCC and Kyoto Protocol), also arguably signals its general dissatisfaction with the procrastination of the American executive and legislature on climate change at the time. For example, the court's frustration in this regard is clearly evidenced by its discussion of the back-and-forth dynamic and impasse between the EPA and Congress on the issue in the late 1980s and early 1990s and the US Senate's subsequent decision not to ratify the Kyoto Protocol due to the absence of major developing country emitters like India and China, all against the backdrop of a growing IPCC scientific consensus.[76] In addition, by directly juxtaposing the historical and socio-political context of US climate change regulation on the one hand and global developments in climate science by the IPCC on the other, the court appears to be assigning to climate science a narrative of progress. In contrast, the court narrates the existing state of US climate change regulation as relatively backward and out-of-sync with global regulatory trends. The court's following commentary is particularly revealing in this regard:

> Congress directed EPA to propose a "coordinated national policy on global climate change"…and that necessary actions must be identified and implemented in time to protect the climate. *Meanwhile the scientific understanding of climate change progressed*. In 1990, the Intergovernmental Panel on Climate Change (IPCC), a multinational scientific body organized under the auspices of the United Nations, published its first comprehensive report on the topic (emphasis mine).[77]

[76] *Massachusetts v EPA*, n53, 4-5.
[77] Ibid, 5.

Furthermore, the EPA's contentions which the court ultimately rejected were based on a 2001 scientific report by the National Research Council (NRC) which stated that that the science of climate change was too uncertain to permit regulation of GHGs. While the court did not explicitly discuss the EPA's use of the NRC report, its rejection of the EPA's contentions on causation in particular indicate its implicit disapproval of the latter's reliance on out-of-date, cherry-picked scientific evidence. Climate science had made significant strides by the time the case was decided in 2007. Therefore, in the six years after the NRC published its report, climate science had developed to demonstrate clear causal links between anthropogenic GHG emissions and climate change. The IPCC Fourth Assessment Report reflected the most up-to-date account of climate science at the time and Working Group I's report on the physical science basis of climate change was released in February 2007 and therefore *before* the court handed down its decision in April 2007.

Taken together, these examples as well as the court's repeated invocation and affirmation of evidence provided by climate scientists on sea-level rise, strongly suggest that at the core of the US Supreme Court's expanding awareness and understanding of climate change is the idea that the decisions of regulatory agencies must be accompanied by a reasonable consideration of the best available and state-of-the-art scientific evidence on the issue. Some legal scholars have described this process of challenging the EPA's regulatory paralysis on climate change as 'expertise-forcing.'[78] It also reveals underlying judicial anxieties about the politicisation of scientific assessment procedures within American administrative agencies as discussed above. As Freeman and Vermeule

[78] J.Freeman et al, n48, 64.

note, "the majority's worry in *MA v EPA* was that politics had disabled the EPA's expert judgment about crucial regulatory questions."[79]

iv. The science-policy-law co-production of climate change facts

Massachusetts v EPA aptly illustrates how national courts serve as key sites of 'co-production' between the judiciary and other actors, including regulatory scientific institutions like the IPCC and climate scientists. This is emblematic of a *science-policy-law co-production* model. It also exemplifies how litigation and adjudication constitute "deeply institutionalized modes of achieving pragmatic closures on epistemic claims and controversies that science alone could not have settled."[80] Some commentators have noted that traditional separation of powers arguments may not apply in such cases, since climate change is an exceptional problem. While traditional doctrinal scholarship envisages that the legislature, executive, and judiciary roughly correspond to the spheres of politics, science/expertise, and law, respectively,[81] some legal scholars have questioned this view in recent times in light of new challenges like climate change. Fisher contends that climate change does not easily fit into a scientific, legal, or political box, which renders its operation or treatment in a separation of powers context unclear.[82] As with most administrative law cases, the Supreme Court did not directly make findings of fact[83] and therefore remained within the remit of its jurisdiction *sensu stricto*. However, legal scholars and courts in other common law jurisdictions have read the case as an authoritative judicial statement on the scientific-factual reality of climate change.[84]

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79 J.Freeman et al, n48, 64.
80 Sheila Jasanoff, 'The Practices of Objectivity in Regulatory Science' in Charles Camic, Neil Gross & Michel Lamont (eds), *Social Knowledge in the Making* (University of Chicago Press 2011) 135.
81 E.Fisher, n43, 247.
82 Ibid, 247.
83 Ibid, 250.
84 Ibid; See Brian J. Preston, 'Climate Change Litigation (Part 2)' (2011) 5 *Carbon & Climate Law Review* 2.

It is therefore worth briefly considering the role that the US Supreme Court played in co-producing not only the case's factual record, but also ultimately the dominant scientific-epistemic imaginary of climate change disseminated by the IPCC.

Notably, the Supreme Court majority made a conscious choice to privilege IPCC assessments and the IPCC scientific consensus over alternative accounts of climate science, namely National Research Council (NRC) reports relied upon by the EPA which were out-of-date.[85] The case is also an illustration of how federal judges are directly integrating IPCC statements into their own factual-legal matrix. Through both these measures, the Supreme Court augmented the epistemic authority of the IPCC. For example, in his discussion of the facts and procedural issues such as standing, Justice Stevens directly subsumed the factual determinations of the IPCC and climate scientists like Michael MacCracken.[86] Similarly, Justice Breyer who aligned himself with the majority, typically assumes a deferential stance in cases involving scientific complexity. As Jasanoff observes, "for Breyer, it is nature's text that takes precedence, and his reasoning repeatedly draws affirmation from expert accounts of reality."[87] Although Breyer did not file a separate opinion in this case, his statements during the oral arguments reveal a clear preference for "conceptualizing risk in quantitative terms"[88] and deferring to scientists' probabilistic methods of calculating risk.

At a glance, the co-productive labours of the court with respect to fact-finding in *Massachusetts v EPA* appear to be limited to the legitimation of a dominant natural

[85] *Massachusetts v EPA*, n53, 5-6, 10, 18.
[86] Ibid, 18-19.
[87] Sheila Jasanoff, "The Practices of Objectivity in Regulatory Science," in Charles Camic, Neil Gross, and Michel Lamont (eds), *Social Knowledge in the Making* (University of Chicago Press, Chicago, 2011) 329.
[88] Ibid, 329.

scientific understanding of climate change. On closer inspection however the court's role extends beyond the certification of IPCC climate science. Rather, *Massachusetts v EPA* and other climate change cases show that American courts are also playing a vital role in transforming scientific facts produced by other actors like the IPCC and climate scientists into what Latour calls "matters of fact" [89] or justiciable facts. More importantly, the judicial confirmation that GHG emissions qualify as air pollutants under the CAA, constitutes strong evidence of *science-policy-law co-production*, as it is the quintessential example of a co-produced 'fact' about climate change.

The role of courts in climate change cases is therefore complex, significant, and one that complements the IPCC's role as a knowledge producer and certifier. Courts are co-producing climate change not only as a scientific reality, but also reinscribing it into a *socio-legal* reality that urgently merits regulatory interventions and responses. In conjunction with the IPCC, they are creating *actionable facts* that generate demand for urgent regulation. More specifically, they are stipulating that climate change is not just a scientific reality, but a social problem or ill because it is detrimental to human health and the environment. For example, in *Massachusetts v EPA*, the Supreme Court's reliance on climate science demonstrating the causal links between GHGs and harmful health and environmental impacts heavily informed its characterisation of GHGs as 'air pollutants' under the CAA. Judicial exercises in identifying climate-related harms, in turn, serve to reinforce and enhance the IPCC's epistemic authority. *Massachusetts v EPA* is the prime example in this regard, because it is a direct judicial imprimatur for regulators to act on the best available scientific data showing evidence of *harm* to human

[89] Bruno Latour, 'Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern' (2004) 30 *Critical Inquiry* 2, 236.

health and the environment from anthropogenic GHGs. This eventually led to the EPA's endangerment finding with respect to GHGs in 2009. In sum, the judgment represents an instance of *science-policy-law co-production* precisely because the Supreme Court majority's interpretation and reading in of GHG emissions as 'air pollutants' under the CAA by reference to IPCC assessments, prompted a change in federal climate change policy in the form of the EPA's endangerment finding in relation to GHG emissions and compelled their subsequent regulation.

Despite judicial claims to scientific and legal forms of objectivity,[90] it is not possible even for courts to disaggregate the complex mix of social-scientific-legal factors in the context of climate change, since they are inextricably intertwined.[91] A survey of US case law reveals that for courts a 'fact' about climate change is not purely made up of scientific propositions, but is additionally inflected with socio-legal factors and considerations. The factual account of climate change produced, legitimated, and disseminated by courts is therefore a framing of the problem as both a scientific reality and a social ill, namely as a series of harms to human health and the environment. This account is concurrently undergirded by IPCC climate science and a legal-juridical understanding of climate change as a social harm, subsequently translatable and actionable as various categories of *legal harm* (e.g. statutory violations or tortious conduct) that give rise to remedial or damage entitlements for adversely affected actors. This dynamic is further illustrated by other US climate litigation scenarios which are discussed below.

[90] See Jasanoff for a comparative analysis of jurisprudential approaches taken by Justices Scalia and Breyer in cases of scientific complexity. In particular, she notes that Breyer takes up ideas of scientific objectivity, generally deferring to expert accounts of nature, while Scalia holds steadfastly to legal texts which he regards as 'the unambiguous baseline on which reason is based.' S.Jasanoff, n87, 329-330.
[91] E.Fisher, n81, 247.

III. The Causation Conundrum

To date, American federal courts have mainly considered climate change causation and any relevant climate science at the procedural stage of litigation, namely when dealing with the question of *standing*. The standing doctrine, deriving from Article III of the US Constitution, prescribes that the jurisdiction of federal courts will be limited to cases in which: i) the plaintiff has suffered an *injury* in fact; (ii) that is 'fairly traceable' to the defendant's misconduct (causation); and (iii) is capable of being *redressed* by the court.[92] Furthermore, courts generally need to be convinced of two main aspects of causation: i) that GHG emissions cause anthropogenic climate change (i.e. the *general causation* enquiry); ii) that a defendant's GHG emissions are the cause of the particular climatic event that resulted in harm or injury to the plaintiff (i.e. the *specific* or *proximate causation* enquiry).[93]

With respect to the first limb of general causation, this section draws on relevant case law examples to argue that American federal courts have widely embraced the scientific consensus on climate change and are near-unanimous in their affirmation of the IPCC and the global climate science community's general proposition that anthropogenically emitted GHGs are the *dominant cause* of climate change. The latter enquiry pertaining to specific causation goes to the issue of attribution of liability to individual corporate defendants (e.g. fossil fuel producers) for particular climatic events that resulted in plaintiffs' injuries. Nearly all causation claims in toxic tort cases (of which asbestos, tobacco, and climate change cases constitute prominent categories) stand or fall on

[92] U.S. Constitution, Art III.
[93] James Thornton & Howard Covington, 'Climate change before the court' (2016) 9 *Nature Geoscience* 3, 5.

expert testimony.[94] Private climate litigation, particularly first generation tort cases, show that courts have thus far refrained from definitively ruling on this second limb of the causation enquiry, citing insufficiency of scientific evidence or scientific uncertainty as major reasons. However, the failure of private climate litigation in the US can also be attributed to non-scientific factors. In all first-generation climate change tort cases courts also dismissed plaintiffs' claims on the basis of: i) the *political question doctrine*, which stipulates that federal courts cannot adjudicate on certain controversies that are more appropriate for resolution by the elected branches of government[95] or; ii) the *displacement doctrine*, which prescribes that federal statute, namely the EPA's authority to regulate GHGs under the CAA, displaces the federal common law of tort with respect to climate change matters.[96]

i. Judicial convergence on general causation

Despite the persistence and pervasiveness of climate skepticism and denialism in the American political establishment, several American courts have accepted the IPCC scientific consensus which has translated into their acceptance of the general causation threshold that anthropogenic GHG emissions are directly contributing to climate change. Indeed, since *Massachusetts v EPA*, the IPCC and climate scientists' key propositions regarding the causal links between GHG emissions and climate change have generally not been questioned by courts. This is aptly illustrated by *AEP v Connecticut* in which the plaintiffs (Connecticut and several other states) filed a public nuisance lawsuit against five electric power companies, which it alleged were the largest

[94] Thomas O. McGarity, 'Daubert and the Proper Role for the Courts in Health, Safety, and Environmental Regulation' (2005) 95 *American Journal of Public Health* 1, 93.
[95] *People of the State of California v General Motors Corp*, No. C06-05755, (N.D. Cal., 09/17/2007); *Kivalina v ExxonMobil Corporation et al*. 696 F.3d 849, 2012 WL 4215921 (9th Cir. 2012); *Comer v Murphy Oil USA Inc*., 607 F.3d 1049 (5th Cir. 2010).
[96] *American Electric Power Co. et al. v Connecticut* (No. 10-174) 582 F. 3d 309 (2011).

emitters of carbon-dioxide in the US.[97] The Second Circuit Court of Appeals (COA) reversed the District Court's initial dismissal of the plaintiffs' claims on the basis that they raised a non-justiciable political question. In doing so, the COA effectively ruled that federal courts are not automatically precluded from reviewing climate change matters – a finding that was also upheld by the Supreme Court. The Supreme Court affirmed the scientific basis of the EPA's endangerment finding in 2009, which integrated statements of fact provided by climate scientists both within the agency and beyond:

> Responding to our decision in *Massachusetts*, EPA undertook greenhouse gas regulation…EPA concluded that "compelling evidence" supported the "attribution of observed climate change to anthropogenic" emissions of greenhouse gases. Consequent dangers of greenhouse gas emissions, EPA determined, included increases in heat-related deaths; coastal inundation and erosion caused by melting icecaps and rising sea levels; more frequent and intense hurricanes, floods, and other "extreme weather events" that cause death and destroy infrastructure; drought due to reductions in mountain snowpack and shifting precipitation patterns; destruction of ecosystems supporting animals and plants; and potentially "significant disruptions" of food production.[98]

The COA and Supreme Court also accepted causation-related claims that the defendants/petitioners' conduct constituted "substantial and unreasonable interference" with the public's rights in violation of the common law of nuisance.[99] In support of their claims, the plaintiffs submitted evidence showing that the defendants contributed to 25% of all emissions from the electric power sector, 10% of all human activities, and 2% of all global emissions.[100] Notably, the Supreme Court dismissed the case on the merits not

[97] *AEP v Connecticut*, n96.
[98] *AEP v Connecticut*, 564 U.S. 3 (2011).
[99] Ibid, 9.
[100] *AEP v Connecticut*, n98, 9.

because of insufficient scientific evidence on causation, but rather on the basis of the displacement doctrine. The court ruled that the CAA and the EPA's exclusive statutory authority to regulate GHG emissions displaced the plaintiffs' claims under the federal common law of nuisance.[101]

Even in exceptional cases in which litigants have challenged climate science and the IPCC consensus, federal courts have not accepted their climate-skeptic claims. For example, in *Green Mountain Chrysler Plymouth Dodge Jeep v. Crombie,* where the plaintiffs (motor-vehicle manufacturers) challenged climate science, the federal District Court of Vermont ultimately accepted the testimony of three climate scientists and upheld the Vermont regulation targeting GHG emissions from motor-vehicles.[102] The plaintiffs challenged these state regulations on GHGs on the basis that they pre-emptively adopted Californian emissions standards in violation of the federal statutory regime on climate change, namely the CAA, the Environmental Policy and Conservation Act (EPCA) and the EPA's exclusive authority to regulate GHG emissions from new motor-vehicles. The plaintiffs also sought to have the expert testimonies of climate scientists Dr James Hansen, Dr Barrett Rock, and Mr K.G.Duleep struck out under the *Daubert* admissibility criteria. The court applied the *Daubert* criteria to assess the reliability of expert evidence presented by these climate scientists and considered their testimonies at length. With respect to James Hansen's testimony, the court concluded the following:

> Hansen's testimony is based on sufficient facts and data and reliable methods, applied reliably to the facts. Hansen cited abundant data in support of his theories regarding climate change, including historical data gathered from a number of

[101] *AEP v Connecticut*, n98, 10.
[102] *Green Mountain Chrysler*, n3.

> sources including measured temperatures, ice cores and ocean cores, as well as modeling results. He also cited substantial data regarding the likelihood of ice sheet disintegration, including satellite imagery and the GRACE satellite's gravitational field data showing recent losses of mass in Greenland and Antarctica, increases in ice quakes in Greenland, recent accelerations in ice streams flowing off Greenland, and historical data on sea level rise at other warm periods in paleoclimate history.[103]

Furthermore, with respect to the peer review criterion, the court noted that "there is widespread acceptance of the basic premises that underlie Hansen's testimony" and that the plaintiffs' own expert, Dr Christy, "agrees with the IPCC's assessment that in the light of new evidence and taking into account remaining uncertainties, most of the observed warming over the last fifty years is likely to have been due to the increase in GHG concentrations."[104] The court accordingly determined that Hansen's testimony was reliable for the purposes of admissibility, and "[provided] the Court with important information on the nature and risks of global warming."[105] Critically, the court noted that Hansen's testimony "provided valuable context for the Court's consideration of the plaintiffs' contentions [and] assists the Court, as the trier of fact in this case."[106] These statements by the Vermont District Court attest to the centrality and indispensable character of IPCC assessments and the expert testimonies of climate scientists (as lead authors of IPCC reports) in judicial fact-finding in climate change cases. The case also highlights the subtle shift in the US federal judiciary's role vis-à-vis scientific evidence on climate change in the past decade. More specifically, it shows that IPCC reports have become well-insulated and progressively consolidated through further federal court

[103] *Green Mountain Chrysler*, n3, 44.
[104] Ibid.
[105] Ibid, 47.
[106] Ibid, 47-48.

rulings. Rather, what is sometimes still contested is the appropriateness and reliability of the witnesses chosen to represent and explain this evidence.

Similarly, in *Coalition for Responsible Regulation Inc. v EPA*, a group of industries and states challenged the EPA's endangerment finding on GHGs and a spate of EPA-issued climate change regulations in the wake of *Massachusetts v EPA*, arguing that these were based on faulty science.[107] With respect to its endangerment finding, the claimants accused the EPA of "improperly delegating its judgment" by consulting external scientific organisations and relying on secondary studies.[108] In making its endangerment finding, the EPA had heavily relied upon scientific assessments issued by the IPCC, NRC, and the U.S. Global Climate Research Program (USGCRS).

The D.C. Circuit Court rejected the plaintiffs' claims and found that the EPA had acted lawfully by compiling a substantial record of scientific evidence on the anthropogenic causes of climate change and considering the scientific evidence in a rational manner.[109] Interpreting the Supreme Court's decision in *Massachusetts v EPA*, the Circuit Court determined that the statutory questions that the EPA was required to answer in making its endangerment finding were: i) "whether GHGs may reasonably be anticipated to endanger public health or welfare" and; ii) "whether motor-vehicle emissions cause or contribute to that endangerment."[110] More importantly, the court emphasised that "these questions require a *scientific judgment* about the potential risks greenhouse gas emissions pose to public health or welfare – not policy considerations."[111] With respect

[107] *Coalition for Responsible Regulation Inc. v Environmental Protection Agency* No. 09-1322 (D.C. Cir. June 26, 2012).
[108] Ibid, 32.
[109] Ibid.
[110] Ibid, 23.
[111] Ibid, 23-24.

to the EPA's reliance on assessments from external scientific organisations like the IPCC, NRC, and USGCRS, the court observed the following:

> EPA simply did here what it and other decision-makers must often do to make a science-based judgment: it sought out and reviewed existing scientific evidence to determine whether a particular finding was warranted. It makes no difference that much of the scientific evidence in large part consisted of "syntheses" of individual studies and research.[112]

The Circuit Court's ruling in this case is therefore far-reaching since it is not only an example of *Chevron* deference to government agencies,[113] but also, by extension, an example of judicial deference towards the fact-finding authority and expertise of scientific organisations like the IPCC due to their status as key purveyors of climate science. The court's decision actively encourages and normalises the use and integration of assessments from external scientific organisations within fact-finding processes of administrative agencies like the EPA. Consequently, it ascribes to climate science and syntheses of climate science (such as IPCC assessments) a pivotal role and special status in public climate litigation in the US, which contributes to the distinctiveness of this body of litigation. Following the Supreme Court majority in *Massachusetts v EPA*, the Circuit Court majority in this case also accepted the underlying climate science and its ruling can arguably be read as a more accurate reflection of the US federal judiciary's current position on general climate change causation.

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[112] *Coalition for Responsible Regulation Inc. v EPA*, n107, 27.

[113] In *Chevron USA Inc. v Natural Resources Defense Council Inc.* 467 U.S. 837 (1984), the US Supreme Court established an important principle of administrative law, namely that courts should generally defer to an agency's interpretation of statute unless such interpretations are unreasonable.

ii. Evidentiary difficulties around specific causation

To date, the inability of plaintiffs to satisfy the requirements of specific or proximate causation, namely by demonstrating that their climate-related injuries are fairly traceable to a defendant's GHG emissions, has been a profound obstacle to their success in private climate litigation. The global and multiscalar nature of climate change and the cumulative, diffuse, and transboundary character of GHG emissions, renders it difficult to prove particularised forms of injury in a court of law.[114] In the first generation of climate change cases, federal courts consistently ruled that the plaintiffs had failed to establish a sufficient causal link between the emitting activities of defendants and their climate related injuries and therefore lacked Article III standing to litigate their tort (i.e. public nuisance) claims.[115] At the time that these cases were decided, event attribution science was still in its infancy, which made it impossible to establish a definitive causal connection between single extreme weather events and the GHG emissions of defendants.

In one of the best-known examples of climate tort litigation, *Native Village of Kivalina v ExxonMobil Corp et al.,* the plaintiffs, the Inupiat Eskimo peoples of Kivalina Alaska, brought a public nuisance claim against 24 oil, energy, and utility companies. They alleged that the defendants' emitting activities caused climate change related harms to Kivalina (erosion of coastal land, sea-ice and permafrost melt, increased frequency and severity of coastal storms resulting in damage to infrastructure etc.) which threatened

[114] Erica D. Kassman, 'How Local Courts Address Global Problems: The Case of Climate Change' (2012) 24 *Duke Journal of International Law* 201, 218; Hari M. Osofsky, 'The Intersection of Scale, Science, and Law in Massachusetts v. EPA' (2007) 101 *Proceedings of the Annual Meeting (American Society of International Law)* 62.

[115] *People of the State of California v General Motors Corp*, No. C06-05755, (N.D. Cal., 09/17/2007); AEP v Connecticut, n96; *Native Village of Kivalina v ExxonMobil Corporation et al*. 696 F.3d 849, 2012 WL 4215921 (9th Cir. 2012); *Comer v Murphy Oil USA Inc*., 607 F.3d 1049 (5th Cir. 2010).

their way of life, induced displacement, and compelled the village's relocation. [116] In support of their claims, the plaintiffs provided a detailed account of the impact of climate change on Kivalina. They specifically alleged that the sea ice, which acts as a protective barrier to coastal storms, was melting earlier, leaving the village exposed to coastal storms and surges.[117] The resulting erosion had therefore reached a point that rendered Kivalina uninhabitable.[118] Consequently, they sought damages and relocation costs estimated to be between $90 and $400 million by the US Army Corps of Engineers.[119] At the outset, the court accepted these documented climate change impacts on Kivalina as part of the case's factual record.

The court also did not question the existence of a general causal link between GHG emissions and anthropogenic climate change or the underlying scientific consensus, but ruled that there was insufficient evidence to prove the causal link between the emissions of particular corporate defendants and the plaintiffs' injuries. More specifically, the plaintiffs' claims failed due to their inability to prove specific or proximate causation under the standing doctrine. The plaintiffs drew on causation theories from water pollution cases, arguing that a "contribution approach" could be applied here to show that the defendants' emitting conduct constituted the "seed of their injury." [120] Given that these claims were brought under the common law of nuisance, the District Court however exhibited reluctance to embrace and extend theories of causation typically applied in statutory contexts with respect to air and water pollution. The court rejected the plaintiffs' causation arguments by emphasising the distinction between statutory

[116] *Kivalina*, n115, 868.
[117] Ibid.
[118] Ibid.
[119] Ibid.
[120] Ibid, at 879 quoting *Tex. Indep. Producers and Royalty Owners Ass'n v. EPA*, 410 F.3d 964 974 (7th Cir. 2005).

claims and common law nuisance claims. The court pointed to the fact that the Clean Water Act, which governs water pollution, establishes an important statutory presumption that discharge exceeding congressionally mandated limits gives rise to a substantial likelihood that the defendant caused the plaintiff's harm, regardless of whether other parties made similar discharges.[121] No analogous federal standard existed with respect to GHG emissions.[122]

Furthermore, the court held that the plaintiffs were unable to show that their injuries were fairly traceable to the defendants' conduct, since GHG emissions are diffuse, undifferentiated and cannot be traced to any particular source.[123] Accordingly, it noted that:

> It is not possible to state which emissions – emitted by whom and at what time in the last several centuries and at what place in the world – "caused" plaintiffs' alleged global warming related injuries. Thus, the plaintiffs have not and cannot show that defendants' conduct is the seed of their injury.[124]

The court ultimately ruled that the plaintiffs' nuisance claim failed for lack of Article III standing and was also barred by the political question doctrine because the issue of climate change required an initial policy determination by the Executive.[125] On appeal, the 9th Circuit Court affirmed the District Court's judgment and further ruled that the CAA displaces the federal common law of nuisance in relation to the regulation of GHG emissions.[126]

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121 *Kivalina*, n115, 879-880
122 Ibid.
123 Ibid, 880.
124 Ibid, 880-881.
125 Ibid, 863, 883.
126 *Native Village of Kivalina v ExxonMobil Corp et al*. No. 09-17490 D.C. No. 4:08-cv-01138-SBA.

In a similar lawsuit, *Comer v Murphy*, a group of plaintiffs from Louisiana brought a class action suit against several oil and coal companies in the common law of tort (nuisance, negligence, civil conspiracy, trespass, fraudulent misrepresentation and concealment) alleging that the latter's emissions contributed to rising sea levels and the intensity of Hurricane Katrina, which resulted in damage to their properties.[127] The plaintiffs sought monetary damages for their injuries. In August 2007, the District Court conducted a hearing concerning the coal companies' motion to dismiss, which it granted.[128] Like the court in *Kivalina,* it held that the plaintiffs lacked standing as they were unable to demonstrate that their injuries were 'fairly traceable' to the defendants' conduct and their claims were non-justiciable under the political question doctrine.[129] These earlier examples of climate tort litigation are also notable for what they miss, as illustrated by the failure of federal trial courts in many cases to undertake independent fact-finding and meaningfully consider any available and relevant event attribution science in accordance with the *Daubert* criteria for the admissibility of scientific evidence. In *Kivalina,* the District Court clearly envisaged a very limited judicial role on climate change matters, which it considered to be the subject of policy determinations by the elected branches of government. Thus, it failed to embrace even its jurisdictionally-sanctioned role as gatekeeper. Both cases were dismissed for lack of standing and raising non-justiciable political questions. Notably, preliminary causation assessments (i.e. as a subset of the procedural standing requirement[130]) were undertaken without any judicial consideration of climate science. In *Comer*, the District Court merely took judicial notice of IPCC assessments submitted by the plaintiffs, which had no direct bearing on its decision-making. Ultimately, both courts adopted a position of

127 *Comer*, n115.
128 Ibid.
129 *Comer v. Murphy Oil Inc*., 585 F.3d 855 (5th Cir. 2009) (decided Oct. 16, 2009), 864.
130 The standing doctrine is enshrined within Article III of the U.S. Constitution.

extreme deference towards the elected branches of government based on the political question doctrine and without engaging in independent fact-finding or in-depth consideration of scientific evidence on climate change causation. Despite these early examples of unsuccessful US climate tort litigation, in which plaintiffs failed to clear causation hurdles, there are positive signs indicating that courts have stepped up their engagement with climate science in post-Paris climate litigation.

IV. Climate Science in Post-Paris US Climate Litigation

Active judicial engagement and an emergent transnational outlook

Despite significant setbacks in earlier generations of US climate litigation, there are some encouraging signs for claimants from some US judges who have demonstrated an increased willingness to wrestle with the scientific complexity of climate change claims. Judge William Alsup's judgment in the California climate change lawsuit, *City of Oakland v BP p.l.c.*, appears to herald a new direction in US climate litigation from previously passive to more active judicial engagement with climate science. The case did not involve any contestation around climate science by the parties, with Justice Alsup explicitly declaring that the 'issue is not over science.'[131] His decision to nevertheless educate himself on climate science in a scientifically uncontentious case is therefore remarkable and fascinating. Prior to the final hearing, he held a special tutorial to familiarise himself with climate science[132] – a move that is unprecedented in US climate adjudication.

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131 *City of Oakland v BP p.l.c* , <http://climatecasechart.com/case/people-state-california-v-bp-plc-oakland/?cn-reloaded=1> accessed 30 October 2018, 6.

132 Science, 'In a San Francisco courtroom, climate science get its day on the docket' (22 March 2018) *Sciencemag.org* < http://www.sciencemag.org/news/2018/03/san-francisco-court-room-climate-science-gets-its-day-docket> accessed 2 July 2018. On 27 February 2018, the Federal District Court of Northern California issued a notice requesting the counsel to the parties to hold a two-part science tutorial on climate change on 21 March 2018. *City of Oakland v BP p.l.c*, No. C 17-06011 WHA (2018).

In stark contrast to the District Court judges in *Kivalina* and *Comer*, Judge Alsup devoted considerable time and effort towards understanding climate science. This heralds a shift from passive judicial acceptance to more active judicial engagement with climate science. For example, he provided the parties with a list of eight questions for the tutorial including "what is the mechanism by which infrared radiation trapped by CO2 in the atmosphere is turned into heat and finds its way back to sea-level?" and "what are the main sources of CO2 that account for the incremental buildup of CO2 in the atmosphere?"[133] The District Court of Northern California also provided the parties with an hour to 'trace the history of scientific study of climate change' and an hour to 'set forth the best science now available on global warming, glacier melt, sea rise, and coastal flooding.'[134] Over the course of the five-hour tutorial on 21 March 2018, Judge Alsup canvassed and heard opinions from several climate scientists on topics of central importance to the case such as atmospheric warming, sea-level rise and coastal flooding. He acknowledged that IPCC assessments 'make a persuasive case for anthropogenic interference with the climate system,' having significantly improved our understanding of the problem over time and with the Fifth Assessment Report making the reality of global warming 'abundantly clear.'[135] He further recognised that the defendants were among the top ten largest carbon producers and GHG emitters worldwide.[136] Accordingly, he opined that 'this order fully accepts the vast scientific consensus that the combustion of fossil fuels has materially increased atmospheric carbon-dioxide

[133] *City of Oakland v BP p.l.c.*, n131.
[134] Ibid.
[135] Ibid, 3-4.
[136] Ibid, 4.

levels, which in turn has increased the median temperature of the planet and accelerated sea-level rise.'[137]

The questions posed by Judge Alsup to the parties and climate scientists in the tutorial were geared towards the creation of a more accurate factual record for the case[138] through the mapping of climatic scenarios and impacts relevant to the plaintiff's claims regarding California sea-level rise and the resulting destruction of residential property and forced human displacement. According to one of the expert witnesses in the case, Daniel Kanneman, a professor of energy at the University of California, Berkeley, Judge Alsup's questions were 'very solid ground questions [trying] to establish a baseline for dialogue.'[139] Thus, the evidence submitted by the parties and scientists during the tutorial in response to Judge Alsup's questions and the conclusions subsequently drawn by him amounted to science-law co-production of the case's factual record. The fact that such hybridised knowledge emerged out of co-production during the discovery process makes it a fitting example of trans-science.

Judge Alsup concluded that 'this order accepts the science behind global warming' but ultimately dismissed the case on the basis that the problem of climate change requires a 'global political solution' which cannot be delivered by American federal courts.[140] The case has therefore understandably been interpreted by environmental advocates and climate litigants as a significant blow to their efforts to hold fossil fuel companies

[137] *City of Oakland v BP p.l.c*, n131, 12.
[138] The holding of a science tutorial in such cases is unusual, but not unprecedented for Judge Alsup who 'likes to establish a common set of facts before the case moves forward.' Umair Irfan, 'The judge in a federal climate change lawsuit wants a science tutorial,' *Vox* (20 March 2018) <https://www.vox.com/energy-and-environment/2018/3/20/17129354/climate-change-lawsuit-tutorial-alsup> accessed 31 October 2018.
[139] Ibid.
[140] *City of Oakland v BP p.l.c.*, n131, 15.

accountable for climate change. However, *Oakland v BP* should not be read too narrowly or reductively in terms of its unsuccessful outcome. While the case conforms to a pattern of failed climate tort suits in the US, it is more far-reaching than either of its predecessors *Kivalina* and *Comer* in several important aspects. First, the decision amounts to a resounding confirmation from the American federal judiciary that the science of climate change is no longer in dispute and therefore attempts by defendants to smear and discredit climate science are likely to be treated as vexatious and ultimately fail in a court of law.

Second, as with *Massachusetts v EPA*, the case constitutes another prominent example of judicial signalling to the political branches of government to operate from a minimum baseline acceptance of climate science and thereby pursue *evidence-based* regulation and policymaking on climate change. Apparent in Judge Alsup's decision is an appeal to the American Executive and regulatory agencies like the EPA to address questions of how to 'appropriately balance' and 'allocate the pluses and minuses' of climate change 'among the nations of the world,' since it is a problem that deserves a solution on a more vast scale than a district judge…can supply.'[141] In finding that the plaintiffs' claims were justiciable, Judge Alsup implicitly accepted that climate change claims are capable of being framed as localised grievances (in this case California sea-level rise caused by the defendant fossil fuel companies' GHG emissions), but that it is simply beyond the capacity and remit of one court or individual judge to provide pertinent redress. Rather, this role is reserved for the political branches of government. Ultimately his dismissal of the case does not diminish his overarching characterisation of climate change as a pressing and dangerous problem substantiated by climate science, which merits a

[141] *City of Oakland v BP p.l.c.*, n131, 15.

worldwide political solution. Judge Alsup thus acknowledged the international and transnational dimensions of the problem. Despite its outcome, the case can plausibly be interpreted as an emphatic judicial nudge to the executive and legislature that inaction on climate change is untenable from an evidentiary standpoint. This means that political objections to regulatory rulemaking on scientific-evidentiary grounds (i.e. the kind raised by the EPA in *Massachusetts)* and systematic political assaults on climate science are highly unlikely to stand up in court.

A constitutional turn

The role of the American judiciary in the transnationalisation of climate adjudication cannot be understated. Although earlier climate tort litigation has limited potential for replication outside the US, American courts nevertheless remain a major supplier of legal ideas in climate adjudication around the world. This is evidenced by public trust cases such as *Juliana et al v USA* (*The Our Children's Trust Case*),[142] which stands out as an anomaly in the current US climate adjudication and litigation landscape and has had a considerable influence and impact on non-US climate litigation.[143] Outside the

[142] *Kelsey Cascadia Rose Juliana et al. v. United States of America et al* (Our Children's Trust Case) (2016) Case No. 6:15-cv-01517-TC, 4. Over the course of 2018, the US Court of Appeals for the Ninth Circuit has repeatedly denied various applications by the Trump Administration seeking to dismiss the plaintiffs' case. On 30 July 2018, the US Supreme Court unanimously denied the Trump Administration's application for staying the case and ruled in favour of the youth plaintiffs, allowing the case to proceed to trial in the District Court of Oregon.

[143] US case law constitutes a significant reference point for transnational and comparative law scholars as well as some courts and judges in other jurisdictions, as evidenced by the following: Jacqueline Peel and Hari M. Osofsky, 'Climate Change Litigation's Regulatory Pathways: A Comparative Analysis of the United States and Australia" (2013) 35 *Law & Policy* 3. K.M. Murchison, 'Environmental Law in Australia and the United States: A Comparative Overview,' (1995) 22 *B.C. Environmental Affairs Law Review* 503; Elizabeth Fisher, 'Obsession and Expertise: Reflecting on the Scholarly Response to *Massachusetts v EPA*' (2013) 35 *Law & Policy* 3; Lisa Vanhala & Chris Hilson, 'Climate Change Litigation: Symposium Introduction' (2013) 35 *Law & Policy* 3; Lisa Vanhala, 'The comparative politics of courts and climate change' (2013) 22 *Environmental Politics* 3; Joana Setzer & Lisa C. Vanhala, 'Climate change litigation: A review of research on courts and litigants in climate governance' (2019) 10 *WIRES Climate Change*; Brian Preston, 'Climate Change Litigation: Part 1' (2011) 5 *Carbon and Climate Law Review* 1; Brian Preston, 'Climate Change Litigation: Part 2' (2011) 5 *Carbon and Climate Law Review* 2.

US, some national courts rely on foreign precedents in their interpretation and application of domestic laws,[144] including in the fields of environmental protection and climate change.

Juliana et al v USA is a pending class action suit filed in the District Court of Oregon in 2015 by the civil society group Our Children's Trust on behalf of twenty-one young American citizens against the US government (including the President and multiple administrative agencies such as the EPA) and several fossil fuel corporations. The case is also notable for the Oregon District Court judge, Judge Ann Aiken's serious active engagement with climate science in her judgment of 10 November 2016. The court and the parties did not dispute the existence of climate change nor its anthropogenic roots, which were taken as facts.[145] The plaintiffs' claims were supported by declarations from climate scientist James Hansen who also featured as a co-plaintiff on behalf of his granddaughter and future generations. At the outset, Judge Aiken ruled that the case did not raise a non-justiciable political question, since "the question at the heart of this lawsuit was whether the defendants had violated the plaintiffs' constitutional rights – a question that is entirely appropriate for adjudication."[146] Therefore, even though they touched on political issues, the plaintiffs' claims were held not to be barred by the political question doctrine.[147]

With respect to Article III standing, Judge Aiken applied the requirements of the doctrine more flexibly as compared with the District Courts in *Kivalina* and *Comer*. She concluded that the plaintiffs had adequately pleaded their injuries in fact, as

144 See Jeremy Waldron, 'Foreign Law and the Modern Ius Gentium' (2005) 119 *Harvard Law Review* 129; Neil Duxbury, 'The Law of the Land' (2015) 78 *Modern Law Review* 1.
145 *Juliana et al v USA*, n142, 4.
146 Ibid, 16.
147 Ibid, 17.

particularised rather than generalised grievances and therefore had standing.[148] For example, plaintiff Kelsey Juliana successfully alleged that algae blooms affected the water she drinks and low water levels caused by drought killed the salmon the she eats. Plaintiff Roske-Martinez also successfully alleged that increased wildfires and extreme flooding in his place of residence jeopardised his safety. Judge Aiken stated that these plaintiffs had managed to show that these climate related harms affected them in a concrete and personal way even if they were also harms experienced by other people.[149]

With respect to the causation limb of Article III standing, the plaintiffs presented two main arguments. First, they contended that American GHG emissions make up a lion's share of all global emissions, that the defendants had the power to reduce or increase those emissions, and that the defendants exercise that power to promote activities resulting in higher levels of fossil fuel combustion.[150] Secondly, they argued that the defendants failed to use their regulatory power to reduce emissions. More specifically, the Department of Transportation and the EPA, which are respectively tasked with regulating the transportation and power plant sectors –producers of two-thirds (64%) of all US emissions – failed to exercise their power to set robust emissions reduction standards for these sectors.[151] Consequently, their emissions caused climate change that resulted in the plaintiffs' injuries.

Judge Aiken accepted the plaintiffs' causation arguments and remarked on the state of climate science. She acknowledged that "climate science is constantly evolving," citing journal articles in support of her decision.[152] For example, she cited with approval the

[148] *Juliana et al v USA*, n142, 19.
[149] Ibid, 20-21.
[150] Ibid, 25.
[151] Ibid.
[152] Ibid, 23.

work of Kirsten Engel and Jonathan Overpeck stating that "although climate impacts at the regional and local levels are subject, among other things, to the uncertainties of downscaling techniques…our knowledge of the climate is developing at a breakneck pace."[153] Thus, in stark contrast to the District Court in Kivalina, Justice Aiken engaged in independent research on climate change within the remit of her judicial fact-finding authority. However, she also acknowledged the limits of her fact-finding role with respect to climate change causation by affirming the Second Circuit Court's dicta in *Connecticut* v *AEP* that this inquiry is 'best left to the rigors of evidentiary proof at a future stage of the proceedings rather than dispensed with as a threshold question of constitutional standing.'[154] Judge Aiken qualified this by stating that the difficulty in proving this chain of causation (i.e. later at the merits stage) did not inform the justiciability determination in the early stage of the proceedings.[155] She therefore accepted that at this early stage of the proceedings, the plaintiffs had adequately pleaded the existence of a causal link between the defendants' conduct and their injuries and ruled that the plaintiffs had standing to sue."[156]

While notable for its consideration of climate science, *Juliana et al v USA* is also a remarkable and perhaps anomalous example of judicial activism on climate change. The judgment is also far-reaching due to Judge Aiken's interpretation and recognition of a new 'fundamental right to a climate system capable of sustaining human life' under the US constitution.[157] She held that the plaintiffs had adequately alleged the infringement of a fundamental right and accepted their argument that the defendants played "a unique

153 *Juliana et al v USA*, n142, 23-24; Kirsten Engel and Jonathan Overpeck, 'Adaptation and the Courtroom: Judging Climate Science' (2013) 3 *Michigan Journal of Environmental Law* 25.
154 *Juliana et al v USA*, n142, 23; *Connecticut v American Electric Power Co. et al.* 582 F.3d 309, 347 (2d Cir. 2009).
155 *Juliana et al v USA*, n142, 28.
156 Ibid.
157 Ibid, 32.

and central role in creating the current climate crisis," acted with full knowledge of the consequences of their actions, and failed to adequately correct or mitigate the harms they helped create in deliberate indifference to the injuries caused by climate change.[158] She also ruled that the defendants were subject to the federal public trust doctrine and the plaintiffs' claims alleging that the defendants violated their fiduciary duties as trustees to protect the environment and climate system for the benefit of future generations was justiciable in a federal court.[159] The defendants' motion to dismiss the lawsuit was accordingly denied. In addition, the US Supreme Court also denied the Trump administration's application for staying the case, allowing it to proceed to trial in October 2018.[160] Our Children's Trust has also filed analogous lawsuits in other states across the US including Massachusetts.

Another striking feature is Judge Aiken's use of scientific knowledge to explicitly frame climate change as a deeply moral issue and as a series of wrongs or injustices. This was particularly apparent from her discussion of the climate harms experienced by youth plaintiffs and the concepts of public trust and intergenerational equity. It was also apparent in her overall characterisation of this lawsuit as, "action [of a] different order than the typical environmental case" in that "it alleges that the defendants' actions or inactions – whether or not they violate any statutory duty – have so profoundly damaged our home planet that they threaten plaintiffs' fundamental constitutional rights to life and liberty."[161] Marking perhaps the boldest judicial declaration yet on the appropriate role of federal courts with respect to climate change, Judge Aiken concluded her judgment by noting that:

158 *Juliana et al v USA*, n142, 35.
159 Ibid, 47.
160 *United States v. U.S. District Court for the District of Oregon*, 18A65 (9th Cir. 2018).
161 *Juliana et al v USA*, n142, 52.

> Federal courts have too often been cautious and overly deferential to [the elected branches of government] in the arena of environmental law, and the world has suffered for it…Even when a case implicates hotly contested political issues, the judiciary must not shrink from its role as a coequal branch of government.[162]

The gravity of the climate change threat also represents a potential opportunity for courts to redefine their roles and, where necessary, to check and hold to account the executive and legislature for their abdication of regulatory responsibilities with respect to climate change. *Juliana et al v USA* also attests to the significance of American courts as exporters of legal ideas, as it is beginning to have a discernible transnational impact. The case is also a pertinent example of the way in which litigants are beginning to use technical bodies of knowledge, including science and law, to promote and realise pressing ethical imperatives relating to climate change, namely the protection and preservation of the planet for future generations. It has inspired analogous constitutional climate change lawsuits in the Global South with youth plaintiffs in Colombia, India and Pakistan suing their governments for violating their rights to life and health through the failure to adequately regulate climate change.[163] This topic is discussed in more detail in Chapter Six.

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[162] *Juliana et al v USA*, n142, 52-54.

[163] See *Pandey v Union of India*, Sabin Center for Climate Change Law: Columbia Law School, 'Climate Case Chart' (2018) < http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2017/20170325_Original-Application-No.-___-of-2017_petition-1.pdf> accessed 23 April 2019*; Rabab Ali v Federation of Pakistan,* Our Children's Trust, 'Global Legal Actions: Pakistan' (2019) < https://www.ourchildrenstrust.org/pakistan> accessed 8 July 2018; *Future Generation v Ministry of the Environment & Others*, Sabin Center for Climate Change Law: Columbia Law School, 'Climate Case Chart' (2018) <http://climatecasechart.com/non-us-case/future-generation-v-ministry-environment-others/> accessed 23 April 2019.

V. Conclusion

The cluster of climate change lawsuits examined here show that certain US federal courts have become important intermediaries in the interactions between the IPCC and domestic policymakers in transnational climate change governance. The above examples of climate litigation show that judges have tended to be deferential towards both scientists and policymakers. Their critical contribution has been in terms of ensuring that administrative conduct and regulation on climate change remains firmly anchored in sound and up-to-date climate science, with IPCC assessments constituting an epistemic baseline. These courts have encouraged greater integration of climate science into domestic climate change regulation. For example, the EPA's rigorous scientific review procedures mandate regulatory decision-makers to rely upon the expertise of hundreds of scientists from both government agencies (e.g. EPA, NASA, NOAA) and external scientific organisations (e.g. IPCC and NRC).[164] More importantly, through their evaluation of IPCC climate science, US federal courts like the Supreme Court have played a pivotal role in co-producing facts on climate change, as attested by its classification of GHG emissions as 'air pollutants' under the CAA in *Massachusetts v EPA*. These interpretive judicial exercises constitute a form of boundary work at the intersection of climate science, policy and law, and are therefore emblematic of *science-policy-law co-production*, as they have concretely translated to policy reform on climate change.

The US climate change cases discussed here also attest to the triangular and complementary nature of the relationship between courts, government agencies and policymakers, and the scientific community. Through this three-way partnership and

[164] T.O.McGarity, n94, 93.

boundary work, courts and legal professionals, regulators and policymakers, and scientists continually work to satisfy the requirements of science, policy and law. More specifically, in collaboration with advocates and litigants, courts are routinely translating scientific statements of fact into categories of climatic harm and legally actionable wrongs (i.e. justiciable matters of fact) that can be adjudicated upon and resolved through the application of relevant legal doctrines and principles – a dynamic further explored in Chapters Five and Six. In this regard, they are concerned not only with uncovering the substantive 'truth' about a climate change-related event and the resulting injury to plaintiffs, but ensuring that an appropriate final outcome is achieved in light of the particular circumstances of a case.

Another crucial contribution and effect of major judicial interventions on climate change in the US has been the reinforcement and augmentation of the epistemic authority of the IPCC. A survey of these major American climate change cases reveals that courts have repeatedly affirmed and reinforced the status of IPCC assessments as an epistemic framework that is indispensable to US climate change policymaking and regulation. The Supreme Court's ruling in *Massachusetts v EPA* unequivocally privileged the IPCC's scientific worldview on climate change and thereby granted the organisation, its knowledge work, and its scientific assessments an added layer of legitimacy. While this limited survey of prominent American climate change cases prevents the development of observations that are generalizable to US climate litigation and adjudication writ large, the Supreme Court's stance on climate science is pivotal. The progressive position of the apex court in relation to IPCC assessments, in conjunction with the doctrine of *stare decisis*, is likely to have considerable sway over other superior courts of record

and lower federal trial courts, and compel them to adopt a similar position in future climate litigation.

Finally, the existing trajectory of US climate litigation in which climate science has featured prominently, shows that certain courts and judges will not accept the wholesale dismantling of federal climate change regulations, particularly in light of *Massachusetts v EPA*.[165] Despite the advent of 'fake news' and a 'post-truth' era following the election of Donald Trump, which has enabled climate denial narratives to flourish in the United States, at least some American federal courts and judges, such as those discussed here, are likely to uphold the IPCC's scientific-factual account of climate change. Indeed, the American federal judiciary's position on climate change has remained intact since 2007 and has not altered with the ebb and flow of American election cycles and changes in government. At a minimum, the jurisprudence of American federal courts to date is arguably a reliable barometer of the fact that climate-skeptic laws and policies are illegitimate and have no place in the American climate change governance. Moreover, procedural doctrines like Article III standing may be more flexibly interpreted and relaxed by courts as the science of event attribution mounts and renders it easier for plaintiffs to establish causation – a topic that is explored in Chapter Six.

[165] However, this remains subject to the important caveat that the composition of the US Supreme Court and the federal judiciary is not irrevocably altered under the Trump Administration. According to some legal commentators, such court packing is already occurring. Furthermore, if Donald Trump is re-elected in 2020, there remains a strong likelihood of further court packing, which may result in the appointment of climate denialist judges. See Jason Zengerie (New York Times Magazine), 'How the Trump Administration is Remaking the Courts' (22 August 2018) < https://www.nytimes.com/2018/08/22/magazine/trump-remaking-courts-judiciary.html> accessed 23 January 2020; Nathan R. Hardy & Richard L. Jolly (Los Angeles Times), 'Opinion. Trump has packed the court with right-wing ideologues. Democrats, what's your plan?' (18 December 2019) < https://www.latimes.com/opinion/story/2019-12-18/donald-trump-judges-federal-courts-conservatives> accessed 23 January 2019.

Post-2015 US climate litigation reflects a shift from previously passive to more active judicial engagement with IPCC climate science among some federal courts, which have become influential as exporters of ideas in this area. Even if US courts have not consciously engineered the transnationalisation of climate change jurisprudence, some high-profile instances of US climate litigation and adjudication have nonetheless served to inspire and drive similar efforts around the world, with *Juliana et al v USA* serving as a major catalyst for a new growing category of public trust and rights-based climate litigation. Moreover, the treatment of IPCC assessments by some American federal courts, including the US Supreme Court, has been replicated by courts around the world, including the Global South. This has resulted in IPCC assessments being transformed into a judicially-accredited evidentiary pillar for climate litigation both in the US and other jurisdictions around the world. These co-productive adjudicative dynamics are further examined and unpacked in Chapters Five and Six.

CHAPTER FIVE

The Science-Law Interface and the Transnationalisation of Climate Adjudication

I. Introduction

In this PhD project, I argue that climate science is being generated through transdisciplinary co-production between the domains of science, policy and law and the key actors steering this process include climate scientists, domestic courts and climate litigants. The byproduct of these co-productive dynamics is an emergent transnational and shared body of legal practice and jurisprudence on climate change, as illustrated in this chapter and Chapter Six. Climate change has been a major catalyst for transnational environmental governance[1] and given rise to new and innovative modes of engagement, coordination and cooperation between state and non-state actors. This chapter examines the role of domestic courts in the co-production and transnationalisation of scientifically-informed climate change jurisprudence. Chapter Four illustrates this dynamic by reference to certain US federal courts, including the Supreme Court. This chapter sits alongside and complements Chapter Four in that it carries forward the same argument by reference to the transnational epistemic-networking activities and climate jurisprudence of judges and domestic courts in other jurisdictions. It specifically argues that through their involvement in a range of judicial networks and fora and their treatment of climate science in litigation, several domestic courts around the world are co-producing a new body of transnational judicial practice and jurisprudence on climate change. Moreover, the science being used in most climate litigation and adjudication is common and, at a minimum, comprises IPCC assessments. This new body of

[1] Harriet Bulkeley et al., *Transnational Climate Change Governance* (CUP 2014); Veerle Heyvaert, 'The Transnationalization of Law: Rethinking Law Through Transnational Environmental Regulation' (2017) 6 *Transnational Environmental Law* 2.

transnational judicial practice and jurisprudence can be alternatively conceptualised as 'transnational legal commons on climate change.'[2]

Alongside public policy, I argue that litigation and adjudication (as defined in Chapter One) have become significant drivers of scientific knowledge production on climate change. Moreover, through interactions in the courtroom and beyond, scientists, judges and litigants are beginning to see themselves as part of a common epistemic-regulatory community or 'transnational community of practice.'[3] While climate science constitutes the primary source of knowledge and evidence in climate litigation, I argue that transdisciplinary mediations by courts are serving to transform climate science into a *usable* body of knowledge for litigation and law reform.

This chapter is structured as follows. Part II reiterates the working definition of networked transnational climate change governance (originally introduced in Chapter One) on which the remaining analysis of this chapter is based. Part III then examines the ways in which national courts function as transnational institutions. In this regard, it considers how transnational judicial networks have emerged and rapidly grown in response to the plethora of transboundary problems engendered by globalisation including environmental challenges like climate change. It is argued that a host of judicial initiatives are strongly suggestive of the emergence of a transnational judicial dialogue on climate change. Information exchange and knowledge sharing on climate

[2] This is a variation on the concept of 'The Common Law of the Environment' developed by UK Supreme Court judge, Lord Carnwath, to refer to a set of environmental law norms and principles that have been disseminated and universalised through regulation, litigation and adjudication. Lord Carnwath, 'Judges and the Common Laws of the Environment – at Home and Abroad' (2014) 26 *Journal of Environmental Law* 177, 187.

[3] Peter M. Haas, 'Introduction: epistemic communities and international policy coordination' (1992) 46 *International Organization* 1, 3; Emanuel Adler, *Communitarian International Relations: The Epistemic Foundations of International Relations* (Routledge 2015) 13. Adler employs the terminology of 'transnational communities of practice.'

science and evidentiary challenges around causation are core constitutive features of these transnational judicial conversations and interactions. Part IV then considers the idea of a 'legal commons' and how some national courts and judges are engaging in the cross-citation of foreign judgments on climate change and co-producing a shared body of climate jurisprudence through the recurrent application and convergent or analogous interpretations of IPCC assessments. This has in turn led to the transnational judicial certification of IPCC assessments. These processes are all strongly indicative of the emergence, growth and consolidation of a distinctive, co-produced and epistemologically hybridised transnational judicial practice and jurisprudence on climate change. Part V offers some concluding observations.

II. The Transnationalisation of Climate Change Adjudication

Transnational climate change governance and the predominance of networks

Climate litigation and adjudication have proliferated globally over the last two decades and are playing a vital role in driving regulation both within and beyond the state.[4] These legal processes have therefore become an important and influential subset of transnational environmental governance. Although there are numerous definitions of transnationalism, for the purposes of this analysis transnationalism or 'transnational relations' are understood as 'regular interactions across national boundaries when at least one actor is a non-state agent or does not operate on behalf of a national government or an intergovernmental actor.'[5] This definition aptly captures the dynamic and relationship between the principal actors in climate litigation, namely

[4] Jacqueline Peel & Hari M. Osofsky, 'Climate change litigation's regulatory pathways: A comparative analysis of the United States and Australia' (2013) 35 *Law & Policy* 3.
[5] Thomas Risse-Kappen, *Bringing Transnational Relations Back In Non-state Actors, Domestic Structures & International Institutions* (CUP 1995) 3; H.Bulkeley et al, n1, 6.

intergovernmental organisations like the IPCC, state or public actors like courts and non-state actors like NGOs which constitute the largest category of plaintiffs.[6] The analysis in this chapter is situated in line with legal and international relations scholarship which understands transnationalism as a phenomenon in which the state itself acts transnationally through its institutions.[7]

Furthermore, as discussed in Chapter One, 'transnational governance' occurs 'when networks operating in the transnational sphere authoritatively steer constituents towards public goals.'[8] These definitions of transnationalism in IR scholarship also align with recent legal scholarship on 'transnational regulation,' which is 'a subset of transnational governance,'[9] and defined as:

> The deliberate exercise of influence on a target's behaviour (designed either to stabilize or modify this behaviour), performed with a certain degree of authority and persistence…in the pursuit of public interest goals [including] environmental protection goals.[10]

Common to all these definitions is the recognition that transnationalism comprises the exercise of multiple and varying forms of authority beyond the state or within the state but with transboundary implications by actors of all different stripes including *inter alia* private, public and non-state actors. Moreover, these exercises of authority are oriented

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6 Michael Burger & Justin Gundlach, 'The Status of Climate Change Litigation: A Global Review' (UNEP, 2017) <http://columbiaclimatelaw.com/files/2017/05/Burger-Gundlach-2017-05-UN-Envt-CC-Litigation.pdf> accessed 29 June 2018.
7 H.Bulkeley et al, n1, 7.
8 Liliana B. Andonova, Michelle M.Betsill & Harriet Bulkeley, 'Transnational Climate Governance' (2009) 9 *Global Environmental Politics* 2, 56.
9 Veerle Heyvaert, 'The Transnationalization of Law: Rethinking Law Through Transnational Environmental Regulation,' (2017) 6 *Transnational Environmental Law* 2, 208.
10 Ibid.

towards the realisation of public interest goals. This chapter as well as the following one focuses on *hybrid transnational governance networks* on climate change which are the product of collaborations between private and public transnational actors[11] including the epistemic community of climate scientists (i.e. the IPCC), domestic courts and litigants (i.e. climate affected communities and NGOs).[12] Key functions of these networks include knowledge production (as discussed in Chapter Two), information diffusion and 'the establishment of a set of norms, rules or standards outside of the intergovernmental arena...' that are geared towards 'steering constituents' and achieving regulatory objectives.[13] The remainder of this chapter considers information diffusion (or knowledge-sharing) and the co-production of scientifically-informed climate jurisprudence by national courts and judges.

National courts as transnational institutions

Many legal scholars have declared that a process of 'judicial globalisation' is underway and refers to the 'phenomenon of high courts (whether international, regional, or national) entering into a global conversation by referring to and borrowing from each other.'[14] However, the term 'transnational' is preferred here over 'international' or 'global' as it is broader and more pertinent for describing the range of interactions that take place between courts and judges both: i) *within* the courtroom through cross-citation of foreign judgments, and; ii) *beyond* the courtroom, including information exchanges, knowledge sharing, technical training and capacity building at conferences

[11] L.B.Andonova et al, n8, 62.
[12] P.M.Haas, n3; E.Adler, n3, 13.
[13] L.B.Andonova et al, n8, 63-64.
[14] Anne-Marie Slaughter, 'A Global Community of Courts' (2003) *Harvard International Law Journal* 41; Anne-Marie Slaughter, 'Courting the World' (2004) 141 *Foreign Policy* 1; Anne-Marie Slaughter, 'Judicial Globalization' (2000) 40 *Virginia Journal of International Law* 4; Carl Baudenbacher, 'Judicial Globalization: New Development or Old Wine in New Bottles?' (2003) 38 *Texas International Law Journal* 505; Martin S. Flaherty, 'Judicial Globalization in the Service of Self-Government' (2006) 20 *Ethics & International Affairs* 4.

and networking events. Legal scholars have used the terms 'transnational judicial dialogue' and 'transnational judicial communities' to describe these types of interactions.[15] Related to this is the idea of 'judicial comity' which connotes deference to foreign courts.[16] According to Slaughter, this is a doctrine that encompasses four strands, namely: i) respect for foreign courts as courts rather than as agents of a foreign government; ii) a recognition that foreign courts are also entitled to their fair share of disputes as co-equals in adjudication with the prerogative to decide local controversies; iii) a distinctive emphasis on individual rights and the judicial role in protecting them, and; iv) recognition that a kind of *legal globalisation* is both a cause and consequence of economic globalisation, which requires judges to play a role in making 'the world's legal systems work together, in harmony, rather than at cross-purposes.'[17]

The proliferation of transnational problems has engendered greater communication and interaction between national courts, particularly superior and constitutional courts. Several national courts now see themselves as major actors in global governance and function as transnational institutions on the basis that they routinely address matters of global concern such as human rights, humanitarian, public health and environmental problems. These courts are also sometimes called upon to interpret states' domestic obligations in accordance with their commitments and obligations under international law. This is aptly illustrated in the arena of environmental law where courts often deal with subject matter that involves international and transboundary dimensions such as air and water pollution, biodiversity loss and climate change.

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15 Olga Frishman, 'Transnational Judicial Dialogue as an Organisational Field' (2013) 19 *European Law Journal* 6, 741; Monica Claes & Maartje de Visser, 'Are you networked yet? On dialogues in European judicial networks' (2012) 8 *Utrecht Law Review* 2, 100.
16 A-M.Slaughter, 'Judicial Globalization,' n14, 1112.
17 A-M.Slaughter, Ibid, 1112-1113; See Justice Stephen Breyer in *Howe v. Goldcorp Investments Ltd*., 946 F.2d 944,950 (1st Cir. 1991).

III. Judicial Climate Networks

Legal scholarship on courts has traditionally focused on the use of foreign precedents by judges in the courtroom.[18] This section broadens the field of enquiry and instead employs an STS actor-network lens to pay close attention to the role of judges with respect to climate change beyond courtroom settings and as part of social associations and assemblages.[19] This is undertaken to develop a richer understanding of how judges are involved in the authoring and diffusion of environmental and climate change norms in varied, less formal ways and in different capacities, including as environmental advocates and climate activists. Through their involvement in *transnational governance networks*, domestic courts and judges are increasingly acting in concert and cooperating with their peers in other jurisdictions on matters of collective concern.[20] The analytic focus here is on *judicial associations*, namely transnational judicial networks and their interventions on climate change, particularly in terms of their transdisciplinary merging of science and law to craft a new body of climate change soft law and jurisprudence and 'authoritative steering' of regulatory bodies towards realising the public interest goals of climate change mitigation and adaptation.[21] It is argued that networked judicial interventions have become a critically important subset and constitutive component of transnational climate change governance writ large.

[18] A-M.Slaughter, 'Judicial Globalization,' n14; Neil Duxbury, 'The Law of the Land' (2015) 78 *Modern Law Review* 1.
[19] Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (OUP, Oxford 2007) 5,7.
[20] H.Bulkeley et al, n1, 7; A-M. Slaughter, 'Courting the World,' n14.
[21] L.B.Andonova et al, n8, 55-56.

Social interactions beyond the courtroom

Beyond the courtroom, judicial conferences and networking events also offer evidence and are constitutive elements of the transnationalisation of climate adjudication. Judicial networks comprise 'fora for the exchange of ideas about legal jurisprudence [and the development] of practical mechanisms for court management.'[22] These interactions are largely horizontal as they involve 'a set of relatively stable non-hierarchical and interdependent relationships in which the participants share a common interest and exchange resources and ideas to achieve common goals.'[23] Furthermore, networked judicial interactions indicate that judges see themselves as part of a 'common enterprise'[24] as evidenced by the formation of judicial coalitions and cooperative institutions that often cohere around particular problems or issues. Prime examples include the Global Judicial Institute on the Environment (GJIE), the European Union Forum of Judges for the Environment (EUFJE) Network and the ASEAN Chief Justices' Roundtable on the Environment. Common goals for these judicial networks typically involve strengthening the environmental rule of law and developing jurisprudence.[25]

Certain judges are ardent proponents of judicial networking in the arena of environmental law given its relatively recent crystallisation into a legal field. For example, Chief Judge Brian Preston of the Land and Environment Court of New South Wales (NSW) in Australia has written and spoken extensively at conferences about the

[22] Hon Justice Rachel Pepper, 'The Role of Judicial Networking and Information Sharing in Promoting and Implementing Environmental Law,' (12 November 2016) <http://www.lec.justice.nsw.gov.au/Documents/Speeches%20and%20Papers/PepperJ/PepperJ%20Judicial%20Networking%20in%20Promoting%20Mutual%20Assistance.pdf> accessed 3 July 2018, 1.
[23] Tania Börzel, 'Organizing Babylon – On the Different Concepts of Policy Networks' (1998) 76 *Public Administration* 253, 254 cited in M.Claes & M. de Visser, n15, 101; R.Pepper, Ibid, 2.
[24] A-M.Slaughter, 'Judicial Globalization,' n14, 1104.
[25] R.Pepper, n22, Ibid.

important contribution of judges to climate litigation.[26] Justice Preston has also recently been involved in several notable extrajudicial initiatives, being both a founding member of the Global Judicial Institute on the Environment[27] (discussed below) and a co-author of the 'Climate Principles for Enterprises' - a soft law instrument prescribing legal obligations for private enterprises in relation to climate change.[28] Similarly, his colleague Justice Rachel Pepper has also outlined the advantages of judicial networks on environmental law in the following emphatic terms:

> The utility of judicial networks resonates loudly in the field of environmental law. This is because environmental law remains a relatively new discipline compared to other more established legal fields, and because it is reactive to scientific and technological advancements (for example, the need to eliminate greenhouse gas emissions) and social and economic developments. These characteristics require environmental law to be dynamic and responsive, something which judicial and legal networks facilitate and encourage.[29]

This aligns with Slaughter's observation that "judges who participate in these networks are rarely motivated by a missionary zeal to build a global system. Rather, they are driven by more prosaic concerns such as judicial politics, the demands of a heavy caseload, and the impact of new international rules on national litigations."[30] These networks are also important to consider as transformative sites out of which important environmental jurisprudence and soft law frameworks on environmental protection

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[26] Brian J. Preston, 'The Contribution of the Courts in Tackling Climate Change' (2016) 28 *Journal of Environmental Law* 1, 11-17.
[27] IUCN World Commission on Environmental Law, 'Global Judicial Institute on the Environment' (2016) *IUCN.org* <https://www.iucn.org/commissions/world-commission-environmental-law/our-work/global-judicial-institute-environment> accessed 31 July 2018.
[28] 'Climate Principles for Enterprises' (2018) <https://climateprinciplesforenterprises.org/> accessed 20 July 2018.
[29] Ibid.
[30] A-M.Slaughter, 'Courting the World,' n14, 79.

might emerge. In this sense, global normative change may sometimes be an unconscious side-effect of networked judicial interactions. Consequently, they merit analytical scrutiny on par with formal courtroom adjudication and resulting jurisprudence.

Judicial conferences and networking events are not new, but well-established traditions in legal systems around the world. Classic domestic examples include conferences and meetings held by bar associations, law societies and law commissions. Prominent international legal conferences on the environment in which judges typically participate include (but are not limited to) those convened by the IUCN such as the World Conservation Congress, UNEP and various university law schools. Perhaps the best known recent examples of such international conferences include the 2012 UN Conference on Sustainable Development in Rio (Rio+20) and the UNFCCC conference of the parties (COPs). These events are held periodically in locations around the world and bring together a range of actors - lawyers, judges, policymakers, government officials, law students, academics, NGOs and civil society activists – from many different countries to exchange knowledge and ideas about environmental protection as well as influence regulatory and normative change.

Judicially-generated soft law frameworks

Perhaps most importantly, transnational judicial interactions and dialogues at the World Environmental Law Congress and the GJIE have recently culminated in the production of soft law instruments including the GJIE Charter, the IUCN World Declaration on the Environmental Rule of Law and the Global Pact for the Environment.[31] Article II of the

[31] Ecolex, 'World Declaration on the Environmental Rule of Law' (2016) < https://www.ecolex.org/details/literature/world-declaration-on-the-environmental-rule-of-law-mon-091064/> accessed 31 July 2018; IUCN, 'Global Pact for the Environment' (2017) <https://www.iucn.org/sites/dev/files/content/documents/draft-project-of-the-global-pact-for-the-

GJIE Charter outlines the GJIE's mission 'to support the role of courts and tribunals in applying and enforcing environmental laws and promoting the environmental rule of law.'[32] Furthermore, the Charter envisages that this mission will be carried out through programs on capacity building, mutual exchange and knowledge-sharing, establishment of a database on environmental cases and judgments, technical assistance, and convening of conferences and symposia.[33] Similarly, the IUCN World Declaration enshrines several important environmental principles, duties and rights including *inter alia*, 'the obligation to protect nature, right to nature and rights of nature, right to environment, ecological sustainability and resilience, *in dubio pro natura*, intragenerational equity and intergenerational equity.'[34]

These principles are not new and derive from earlier instruments such as the 1992 Rio Declaration. However, the recently launched 2017 Global Pact on the Environment seeks to succinctly summarise these key environmental law principles as the basis for a new binding international treaty to complement and sit alongside the Paris Agreement.[35] The other key output of the GJIE, the Brasilia Declaration of Judges on Water Justice, also similarly enshrines several fundamental environmental law principles for the promotion of water justice including the precautionary principle, *in dubio pro aqua* and the polluter pays principle.[36] Eminent jurists like Lord Justice Carnwath of the UK

environment.pdf> accessed 1 August 2018; IUCN, 'Brasilia Declaration of Judges on Water Justice' (2018) <https://www.iucn.org/sites/dev/files/content/documents/brasilia_declaration_of_judges_on_water_justice_21_march_2018_final_as_approved.pdf> accessed 15 October 2018.

32 IUCN World Environmental Congress, 'Charter of the Global Judicial Institute for the Environment' (2016) *IUCN.org* < https://www.iucn.org/sites/dev/files/content/documents/charter-of-the-global-judicial-institute-rio-de-janeiro-29-april-2016-_0.pdf > accessed 31 July 2018, Art II.

33 Ibid, Art III.

34 Ecolex, n31, Principles 1, 2, 3, 4, 5, 7, 8.

35 Global Pact for the Environment, n40; Lord Carnwath, 'Climate Justice and the Global Pact: Judicial Colloquium on Climate Change and Law in Lahore, Pakistan' (26 February 2018) <https://www.supremecourt.uk/docs/speech-180226.pdf> accessed 15 February 2019, 5.

36 Brasilia Declaration, n31, Principles 5, 6, 7.

Supreme Court have opined that the Global Pact constitutes an up-to-date enumeration of universal principles of environmental law agreed at the highest level – 'like a Global Common Law of the Environment.'[37]

Moreover, it is highly likely that these types of soft law instruments will guide and inform judicial thinking, interpretation and jurisprudence in some climate change cases in the foreseeable future. Environmental law principles enshrined in these judicial soft law frameworks may be applied by judges in climate litigation, albeit in accordance with particular national circumstances and contexts. For example, the principles of Ecologically Sustainable Development (ESD), such as the precautionary principle, may be invoked by litigants in an administrative climate change lawsuit. In this context, an environmental impact assessment might require consideration of both direct and indirect (i.e. Scope 3) GHG emissions of a particular development project such as a new coalmine or power plant. Questions regarding the climate change impacts of such development projects will typically require judicial consideration of relevant IPCC climate science. This scenario is discussed in detail by reference to relevant case law and the judicial application of the IPCC's carbon budget framework in Part IV below. As products of transnational judicial dialogues, such soft law instruments already carry considerable weight in certain national courts and serve as adjudication manuals.[38]

The GJIE outputs demonstrate that some contemporary environmental law, including climate change law, is being generated through transnational networked judicial interactions. At a minimum, these incipient environmental law frameworks can be

[37] Brasilia Declaration, Ibid; L.Carnwath, n2, 187.
[38] L.Carnwath, n35, 5.

considered an embodiment of *opinio juris* and assume a soft law format. They also have the potential to crystallise into hard law through recurrent judicial application and interpretation in domestic environmental litigation contexts over time.[39]

Transnational judicial dialogues on climate change and IPCC assessments

The establishment of the GJIE in 2016 at the first IUCN World Environmental Law Congress in Rio provides a strong indication of the existence of an emergent, albeit robust transnational judicial dialogue on climate change. The GJIE is also a fitting example of a transnational judicial network specialising in environmental law. It is an initiative supported by courts and judges from around the world, with countries like India, Brazil, Australia and China serving as leading proponents and key partners.[40] To a lesser degree, American courts are also involved in the work of the GJIE. For example, the participation of Hawai'ian Supreme Court judges is explicable on the basis that Hawai'i is a state in which climate litigation is ascendant given its heightened vulnerability to climatic impacts such as sea-level rise.[41]

Certain judicial statements and declarations emanating from the GJIE meetings provide a plausible basis for recognising an emergent transnational judicial dialogue and jurisprudence on climate change. First, the Chair of the IUCN World Commission on Environmental Law and one of the founding members of the GJIE, Justice Antonio

[39] L.Carnwath, n35, 5.

[40] IUCN World Commission on Environmental Law, 'Global Judicial Institute on the Environment' (2016) <https://www.iucn.org/commissions/world-commission-environmental-law/our-work/global-judicial-institute-environment> accessed 31 July 2018.

[41] Jerry M. Melillo, Terese (T.C.) Richmond, and Gary W. Yohe (eds), 'Climate Change Impacts in the United States: The Third National Climate Assessment' (U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2., 2014) <http://s3.amazonaws.com/nca2014/high/NCA3_Climate_Change_Impacts_in_the_United%20States_HighRes.pdf> accessed 1 August 2018; Charles H. Fletcher et al, 'National Assessment of Shoreline Change: Historical Shoreline Change in the Hawaiian Islands' (2012) <https://pubs.usgs.gov/of/2011/1051/pdf/ofr2011-1051_report_508.pdf> accessed 1 August 2018.

Benjamin of the Brazilian Supreme Court, has declared climate change as 'the single most important legal issue facing judges globally.'[42] Justice Benjamin has stated that a key objective of the GJIE is to educate judges on how to deal with climate change issues as well as build judicial capacity in this regard.[43]

Second, at an annual meeting of the GJIE in May 2017, Hawai'ian Supreme Court Justice Michael Wilson spoke about climate change in particularly emphatic terms as 'the defining issue' for the judicial community.[44] Focusing on its deleterious impacts on Hawai'i, in his presentation to the GJIE he cited climate science at length including the US Third National Climate Assessment Report as well as peer reviewed scientific studies on sea-level rise.[45] In a corresponding paper he also highlighted the 'formidable consensus of the world scientific community' and extensively cited the IPCC's Fifth Assessment Report (AR5), which he argued 'warrants close consideration.'[46] He ultimately concluded that 'IPCC assessments are unqualified, they have been formally accepted by the world's national governments, and thus they can be considered both scientifically and politically, as "known facts." They cannot be ignored if one is committed to an evidence-based approach to public policy and the environmental rule of law.'[47] Relying on these key pieces of climate science, Justice Wilson unequivocally declared climate change to be 'unlike any other social issue' and observed the following:

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[42] Justice Antonio Benjamin as quoted in Justice Michael Wilson, 'Global Judicial Institute for the Environment: Judicial Response to a Planet Under Siege' *IUCN* (2017) '<https://www.iucn.org/sites/dev/files/content/documents/2017/wcel_mike_wilson_pres_judicial_response_to_a_planet_under_siege.pdf.> accessed 31 July 2018.
[43] Ibid.
[44] Ibid.
[45] US Global Change Research Program, 'Third National Climate Assessment Report' (2014) < https://www.globalchange.gov/nca3-downloads-materials > accessed 1 August 2018.
[46] Justice Michael Wilson, 'Climate Change: The Role of Judges' (2017) <https://www.eufje.org/images/docConf/ox2017/wilson.pdf7.> accessed 1 August 2018, 6.
[47] Ibid, 7.

> The dimension of this social issue is without parallel. It has no equivalent. Its gravity deepens with time due to its impending consequences. Carbon emissions must be reduced before the earth hits another degree Celsius. We have a margin of safety of approximately 50 years. This is what is facing the world's judiciary. A solution issue unlike any other that has a **solution horizon**. The solution must occur before the earth warms another one degree Celsius.[48]

Justice Wilson's comments are noteworthy for their recognition of climate change not only as a legal issue confronting the transnational judicial community, but also as a social issue. Taken together, these statements can therefore arguably be read as an implicit judicial acknowledgement of climate change issues as inherently trans-scientific in nature. From such declarations and statements, it is also possible to glean judicial intent which might better enable climate litigants to predict which judges, courts and jurisdictions are likely to be more favourable and receptive to climate change claims.

Judicial dialogues on climate change in the Global South

Some of the most well developed judicial conversations on environmental protection and climate change are taking place in Asia and Latin America. Despite their regionally-specific loci, specialist judicial fora on the environment are essentially transnational in character as judges from other regions also participate.[49] Moreover, the existence of constitutionalised environmental rights and specialist environmental courts in many Asian and Latin American states has also arguably contributed to the proliferation of judicial conferences on the environment in the Global South. These provide judges with

[48] M.Wilson, n46.

[49] For example, Latin American and Australian judges regularly participate in Asian judicial conferences such as the ASEAN Chief Justices' Roundtable on the Environment. See R.Pepper, n22, 2, 7.

the opportunity to directly learn from one another and collectively develop pathways and strategies for addressing identical or analogous environmental and climate change claims.

One of the best known judicial environmental conferences in the Global South is the ASEAN Chief Justices Roundtable on the Environment (CJRE). In its most recent sixth conference proceedings, the CJRE acknowledged climate change as an emerging judicial challenge which, out of all environmental problems, is the most global in scope.[50] The CJRE also took notice of high profile climate litigation from around the world, including the *Urgenda* case and The Hague District Court's acceptance of IPCC assessments. Notably, the CJRE's invitation to an Australian judge, Justice Rachel Pepper of the NSW Land and Environment Court, to provide a survey of climate litigation around the world, indicates the existence of high level transnational engagement and dialogue on climate change between judges in the Asia-Pacific region. Justice Pepper encouraged the ASEAN judiciaries to reverse the burden of proof, relax standing requirements and apply the principle of non-regression in the context of domestic climate litigation.[51] The CJRE report further highlights the possibility of an increase in disputes and litigation around evidenced-based climate change policies before ASEAN courts. It also emphasises the role of judicial networks in promoting mutual assistance through, for example, the establishment of comprehensive and accessible databases for judgments with a view to developing an ASEAN environmental law jurisprudence.[52]

[50] Sixth ASEAN Chief Justices Roundtable on the Environment, 'Forging the Sustainable Future of the Environment: The Proceedings' (February 2018) <https://www.adb.org/sites/default/files/publication/398416/6th-asean-chief-justices-roundtable-proceedings.pdf> accessed 2 August 2018, 28.
[51] Ibid, 31.
[52] Ibid, 37, 39.

Transnational judicial dialogues on climate change are also gaining traction in Latin America. This can be attributed to two major factors. First, the constitutionalisation of environmental rights in several Latin American states (e.g. Brazil, Ecuador and Colombia)[53] and the existence of robust climate change legislation have more easily enabled rights-based environmental and climate litigation, particularly by NGOs and citizen groups. Second, specialist environmental courts and tribunals have proliferated since the year 2000, with over 1200 worldwide. [54] Many of these are situated in the Global South including Latin America. While there is enormous diversity in constitutional adjudication across Latin America,[55] environmental constitutionalism has led to greater jurisprudential cross-fertilisation in environmental cases among Latin American courts. For example, the principle of *in dubio pro natura* (or pro-nature principle) discussed above is often applied by Latin American courts to the interpretation of statutory and constitutional provisions in environmental cases.[56] Therefore, this principle arguably reflects a transnational judicial consensus on the enforcement of the environmental rule of law in Latin America.

States like Brazil have often taken on a *de facto* leadership role in developing such environmental law principles[57] and, in general, promoting transnational judicial

[53] Roderic O'Gorman, 'Environmental Constitutionalism: A Comparative Study' (2017) 6 *Transnational Environmental Law* 3, 435-436, 454.
[54] UNEP, 'Environmental Courts and Tribunals: A Guide for Policymakers,' (2016) <https://wedocs.unep.org/bitstream/handle/20.500.11822/10001/environmental-courts-tribunals.pdf?sequence=1> accessed 2 August 2018, IV.
[55] Patricia Navia & Julio Rios-Figueroa, 'The Constitutional Adjudication Mosaic of Latin America' (2005) 38 *Comparative Political Studies* 2, 213.
[56] Nicholas Bryner, '4.1 Applying the Principle *In Dubio Pro Natura* For Enforcement of Environmental Law,' in Organization of American States, 'Inter-American Congress on the Environmental Rule of Law: Selected Essays,' (2015) < http://www.oas.org/en/sedi/dsd/environmentalruleoflaw_selectedessay_english.pdf> accessed 2 August 2018, 166.
[57] Ibid, 170.

dialogues on environmental and climate change issues. Brazil has played host to many major environmental law conferences dating back to the Rio World Summit in 1992. The Brazilian Association of Judges is also one of the major organisers of the IUCN World Environmental Law Congress, the first session of which Brazil also hosted. Finally, the GJIE was co-founded and is currently chaired by the Chief Justice of the Brazilian Supreme Court, Antonio Benjamin. Taken together, these various interactions between judges outside the courtroom show that the impetus towards judicial transnationalisation is intensifying due to widely held concerns about how courts ought to confront and address climate change and make use of IPCC assessments to do so.

IV. Climate Change in the Courtroom: Crafting a New Legal Commons?

The idea of the 'commons' has long been in circulation in environmental law and policy. The concept 'common heritage of mankind' envisages vital natural resources such as air, the atmosphere, water bodies such as lakes, rivers and oceans, and forests and their protection for the sustainable use and enjoyment of all mankind across generations. It forms an integral part of international environmental law and is referenced in many major environmental treaties and soft law instruments. In contrast, the idea of a corresponding legal commons on the environment (one that goes beyond international law) is less familiar and undertheorised. To date, only Lord Justice Carnwath of the UK Supreme Court has put forward an account of emerging legal principles that constitute the foundation for a 'common law of the environment.'[58] I will similarly argue here that an emergent set of transnational legal practices and principles is identifiable with respect to climate change and forms the basis of an incipient transnational legal commons on

[58] L.Carnwath, n2.

climate change. For example, the 'public trust' doctrine is already inextricably wedded to the idea of 'common heritage of mankind,' as it has historically been applied to cases involving the regulation of air and water (e.g. pollution cases).[59] More specifically, the extension and growing application of the public trust doctrine to the regulation of the climate (i.e. our global atmospheric commons), as exemplified by recent climate litigation such as *Juliana et al v USA,* lends credence to the idea that a legal commons constituted by a shared body of climate change case law or jurisprudence is indeed emerging – a point that is further developed in Chapter Six.

Among the most compelling accounts of a 'legal commons' and theories of foreign law citation, upon which I also draw to make my case, are those offered by Jeremy Waldron. Moving away from the narrower international law idea of *ius gentium,* Waldron invokes the term in its historically broader sense as 'a common law of mankind.'[60] He conceptualises *ius gentium* as law that is not enacted or written in the books, but which nonetheless has its own positivity because it is comprised of convergent currents of foreign statutes, constitutional provisions and precedents.[61] These sometimes add up to a body of law that has its own claim on us as 'law in the world.'[62]

In general, context sensitivity, a need to pay attention to local conditions and legal doctrines like *stare decisis*, compel litigants and judges to prioritise and predominantly apply domestic precedents to resolve legal questions, particularly in jurisdictions like the United States. Waldron contends that *ius gentium* nevertheless retains critical

[59] Anne Richardson Oakes, 'Judicial Resources and the Public Trust Doctrine: A Powerful Tool of Environmental Protection?' (2018) 7 *Transnational Environmental Law* 3, 6-10.
[60] Jeremy Waldron, 'Foreign Law and the Modern Ius Gentium' (2005) 119 *Harvard Law Review* 129, 132.
[61] Ibid, 132-133.
[62] Ibid, 133; Neil Duxbury, 'The Law of the Land,' (2015) 78 *Modern Law Review* 1, 41.

purchase as a vital resource for interpreting and applying domestic laws because it is "a source of normative insight grounded in positive law of various countries and [may] be relevant to the resolution of a legal question in this country."[63] As a repository of accumulated legal wisdom and experience of mankind, it offers useful guidance for the resolution of legal questions and may play an important gap filling role.[64] Holistically addressing a legal question, particularly where the protection of human rights or transboundary environmental problems are concerned, calls for the application of a comparative and transnational law lens that takes into account any existing 'foreign law consensus.'[65]

Waldron draws a helpful analogy with accumulated global scientific practice and problem solving. Using the example of public health, he observes that the exercise of containing epidemics (inherently transboundary in nature) often requires countries to cooperate and have recourse to public health and scientific best practice in other countries and internationally prescribed standards by the World Health Organisation (WHO).[66] Thus, it stands to reason that legal issues with transboundary dimensions also ought to be dealt with in kind, namely by adopting a scientific disposition and having recourse to an established transnational body of legal practice and precedents.[67] Duxbury adds that while courts have no duty to apply foreign precedents, they may feel pressured to do so because of convergent legal and adjudicative practices with respect to an identical or analogous factual scenario.[68] Fairness is achieved where cases with

63 J.Waldron, n60, 143.
64 Ibid, 132-133.
65 Ibid, 140.
66 Ibid, 143.
67 Ibid.
68 N.Duxbury, n62, 45.

materially identical facts are being treated alike irrespective of where the facts arise.[69] In this thesis, I adopt and apply this enlarged conception of transnational adjudication as both cross-citation of foreign judgments (another salient form of transnational judicial dialogue[70]) and structural similarities or convergence in the judicial evaluation of climate science. Consequently, as highlighted in Chapter One, 'legal commons' is understood throughout this thesis to mean a *shared* body of transnational climate change case law or jurisprudence rather than a uniform body of climate change law made up of equivalent norms or principles.

Adjudication and the development of climate change law

Over the past decade, climate change has become a permanent fixture in the sphere of environmental adjudication. In addressing climate change, courts are not overstepping their authority as believed by certain industrial and political elites. Rather, as Fisher and Scotford argue, "in most jurisdictions courts have a duty to adjudicate legal disputes brought before them" and it is through the adjudication of climate change disputes that a complex problem like climate change is subsumed into the legal order.[71] Courts are key institutional actors and architects in the transformation and evolution of legal systems and doctrines in response to transboundary problems like climate change. More specifically, this is occurring through processes of judicial decision-making and the establishment of legal precedents which are constitutive of a common case law of the environment.[72] Some pioneering judges in the field of environment law have unequivocally acknowledged that "adjudication inherently involves judicial law

[69] N.Duxbury, n62, 42; Ronald Dworkin, 'Hard Cases' (1975) 88 *Harvard Law Review* 6.
[70] Anne-Marie Slaughter, 'A Typology of Transjudicial Communication' (1994) 29 *American Journal of International Law* 1, 99-101; C.Baudenbacher, n14, N.Duxbury, n62.
[71] Elizabeth Fisher & Eloise Scotford, 'Climate Change Adjudication: The Need to Foster Legal Capacity: An Editorial Comment' (2016) 28 *Journal of Environmental Law* 1, 4.
[72] See Lord Carnwath, n2.

making."[73] Other legal scholars have argued that this lawmaking component of adjudication is a fundamental pre-requisite for the proper functioning of constitutional democracies, particularly when minority rights are endangered by majoritarian institutions.[74]

The linchpin of this process is the judicial interpretation of legislation and consideration of administrative decision-making (e.g. consent for land use and development projects), which is largely the focus of my discussion here. As noted by Justice Preston of the NSW LEC, judicial interpretive processes are vital in relation to environmental legislation "which is drawn as a framework of rules expressed at a high level of generality. A court can, by interpretation of the legislation, flesh out the skeletal framework both in meaning and in application to the facts of the dispute before the court."[75] In accordance with this framing, I argue that judges have integrated and routinised the use of IPCC outputs as interpretive aids in climate adjudication. In sum, the principal processes through which judges are contributing to legal-doctrinal evolution and the development of a shared transnational body of case law or jurisprudence on climate change include: i) the accreditation of IPCC assessments (i.e. a shared evidence base) and; ii) shared interpretation and reasoning of the evidence base as attested by the application of the IPCC's 'carbon budget' framework in post-Paris climate adjudication, which highlights similar judicial approaches to grappling with the multi-scalar nature of climate change and with claims that the contribution of individual actors/states to climate change is negligible or a 'drop in the ocean.'

[73] Brian J. Preston, 'The Contribution of the Courts in Tackling Climate Change' (2016) 28 *Journal of Environmental Law* 1, 15; See also Laura Burgers, 'Should Judges Make Climate Change Law?' (2020) *Transnational Environmental Law* (forthcoming), 2, 6, 21.
[74] L.Burgers, Ibid, 21.
[75] Ibid.

i. The transnational judicial accreditation of IPCC Assessments: A shared evidence base

Chapter Four examined the judicial treatment of climate science in high profile climate change lawsuits in the United States. This section provides a complementary analysis of the treatment of climate science by courts, with a spotlight on non-US climate litigation. Several climate change lawsuits provide a clear indication of a transnational judicial consensus on the status of IPCC Assessments as a valid epistemic-evidentiary foundation for climate litigation. In sum, transnational climate change adjudication has resulted in the elevation of IPCC assessments as a judicially-accredited body of science and a Global Knowledge Commons for evidence-based policymaking and regulation.

A shared epistemic-evidentiary foundation in the form of IPCC assessments is a common thread that runs through many climate change lawsuits. Scientifically-informed climate adjudication is, in turn, putting pressure on governments around the world to consider and integrate up-to-date climate science (at a minimum IPCC assessments) into governmental decision-making frameworks. *Urgenda v The Netherlands* (*Urgenda I)* is at the forefront of this growing trend. The IPCC's Fifth Assessment Report (AR5) served as the primary evidentiary basis of the plaintiffs' claims against the Dutch government. The Hague District Court accepted that a "causal link can be assumed between Dutch greenhouse gas emissions, climate change and the effects (now and in the future) on the Dutch living climate."[76] Finding in favour of Urgenda and accepting

[76] *Stichting Urgenda v. Government of the Netherlands (Ministry of Infrastructure and the Environment) (Urgenda I)*, ECLI:NL:RBDHA:2015:7145, Rechtbank Den Haag, C/09/456689/HA ZA 13-1396, Hague District Court Verdict, at [4.90].

the state of climate science as established by IPCC assessments as fact, the court ordered the Dutch government to reduce the Netherlands' GHG emissions by 25% below 1990 levels by 2020.[77] While an Urgenda-style lawsuit may be difficult to transpose to jurisdictions outside the Netherlands due to differentiated understandings and implementation of the separation of powers,[78] the case has wider resonance and is potentially exportable with respect to the court's treatment and validation of climate science and IPCC assessments as a basis for interpreting a state's obligations on climate change mitigation under the Paris Agreement.

Following *Urgenda I*, a transnational judicial conversation on the central importance of IPCC assessments in climate litigation and adjudication is flourishing within the EU and beyond. Indeed, in the near-identical *Klimaatzaak* case, the Belgian Court of First Instance adopted similar reasoning to its Dutch counterpart in *Urgenda* to issue a declaration in 2016 stating that the federal and regional governments in Belgium have failed to adopt mitigation targets in accordance with the law, namely 40% below 1990 levels by 2020 and 87.5% below 1990 levels by 2050.[79]

IPCC assessments also constitute the evidentiary core of the plaintiffs' claims in *Saul Luciano Lliuya v RWE*, a lawsuit filed in Germany by a Peruvian farmer against the German power company RWE. On 13 November 2017, the plaintiff was successful in

[77] *Urgenda*, n76, at [5.1].
[78] Ibid. I refer here to the United States where the political question and displacement doctrines operate to exclude the power of the judiciary to consider federal common law public nuisance claims. More specifically, in contrast to civil law jurisdictions like the Netherlands, the separation of powers (of which the political question and displacement doctrines are constituent elements) has been frequently invoked and employed as a boundary policing mechanism by the American federal judiciary to exclude climate change matters brought under the common law of tort as discussed above.
[79] Both *Urgenda* and *Klimaatzaak* are currently pending on appeal. See *VFW Klimaatzaak v Kingdom of Belgium et al* (Court of First Instance, Brussels, 2015) < http://www.lse.ac.uk/GranthamInstitute/litigation/vzw-klimaatzaak-v-kingdom-of-belgium-et-al-court-of-first-instance-brussels-2015/> accessed 27 August 2018.

his appeal at the Higher Regional Court in Hamm, setting a new landmark precedent for private climate litigation against large corporate emitters and thereby increasing the likelihood of analogous cases being filed across Europe and beyond. At the oral hearing, the court held the plaintiff's appeal admissible and opined that his claims had merit and that the case is likely to proceed to the evidentiary stage.[80] The court accepted the underlying climate science which comprised a combination of IPCC assessments and event attribution studies documenting substantial glacial melt and flood risk in the Andes. At the time of writing, it remains to be seen whether the court will be receptive to the plaintiff's line of argumentation on causation at the evidence hearing. However, the signs are positive since the court has already declared that 'while RWE's emissions are not wholly responsible for the flood risk to Huaraz, it is enough that its emissions are *partially responsible* for the actual, present risk.'[81] Accordingly, the Court held that there is no legal basis to rule out the existence of *partial causation* in this case.[82] Notably, the Court also considered climate models (i.e. GCMs) to be an appropriate source of evidence in this case and concluded that the question of whether RWE's emissions are partially contributing to the endangerment of the plaintiff's hometown of Huaraz is a *scientific determination*.[83]

In a more proactive vein, the Hamm regional court also went beyond IPCC assessments, requesting the claimant to provide further scientific evidence on attribution at the evidence hearing. This suggests that IPCC assessments are only the baseline of scientific

[80] Agence France-Press, "Peruvian farmer sues German energy company for contributing to climate change" *The Guardian* (14 November 2017) < https://www.theguardian.com/world/2017/nov/14/peruvian-farmer-sues-german-energy-giant-rwe-climate-change> accessed 14 November 2017.
[81] Germanwatch, 'General ruling of the civil high court in Hamm' (14 November 2017) < https://germanwatch.org/en/huaraz> accessed 14 November 2017.
[82] Ibid.
[83] Ibid.

evidence required in climate litigation. When specific questions about loss, damage and liability arise, a court is likely to request further scientific evidence on attribution. The relationship between IPCC assessments and event attribution science can accordingly be characterised as follows: as first tier (general causation) and second tier (specific causation) bodies of evidence, respectively, that serve to complement one another at different stages of climate litigation.

One possible interpretation is that courts have tended to rely on IPCC assessments to get around procedural or jurisdictional hurdles (e.g. the US Article III standing or political question doctrines) to adjudicate climate change matters as questions of law and are likely to demand further tailored attribution science on single extreme events at the merits stage. This is difficult to establish with certainty since, to date, most climate litigation has not progressed to the merits stage. However, *Lliuya v RWE* illustrates a new trajectory in climate litigation and adjudication with attribution science gaining traction and occupying a central role at the merits stage in relation to questions of loss, damage and liability. In sum, both IPCC assessments and climate attribution studies are bodies of trans-science that are serving as adjudicatory aids for addressing climate causation enquiries. The latter is a prime example of what STS scholars describe as science that does not pre-exist the controversy, but is 'contingently constructed' to resolve questions arising out of a specific legal case.[84]

Courts in Australia and New Zealand have also made pronouncements on IPCC assessments, indicating that they constitute sound scientific evidence for climate

[84] Sheila Jasanoff, 'Representation and Re-presentation in Litigation Science' (2008) 116 *Environmental Health Perspectives* 1, 124.

litigation and adjudication. In the New Zealand case of *Thomson v Minister for Climate Change* (NZ), the High Court considered IPCC AR5 at length, noting that it 'is the most comprehensive assessment of knowledge of climate change since its predecessor' and the 'best available synthesis of the literature and forms a sound body of evidence.'[85] It concluded that the Minister for Climate Change ought to have reviewed AR5 when determining New Zealand's Nationally Determined Contribution (NDC) under the Paris Agreement and its national emissions mitigation target, but made no reviewable error.[86]

The Court stressed that 'IPCC Reports provide a factual basis on which [regulatory] decisions can be made.'[87] It also heard and accepted expert evidence from several climatologists including James Hansen, David Frame (a lead author on IPCC Working Group I) and James Renwick (a lead author of AR5 and AR4) which was submitted in support of the plaintiff's claims. In their testimonies, these climate scientists offered extended explanations of the conclusions drawn in IPCC AR5 pertaining to increased atmospheric warming, sea-ice melt and sea-level rise.[88] Engaging in a transnationalist exercise of cross-citation, the court also drew upon several foreign climate change lawsuits ranging from *Massachusetts v EPA,*[89] *Juliana et al v USA,*[90] *Friends of the Earth v Canada,*[91] *ClientEarth v Secretary of State*[92] and *Urgenda,*[93] to conclude that climate change questions are generally likely to be justiciable and that 'it may be

85 *Sarah Thomson v Minister for Climate Change* [2017] NZHC 733, at [9]-[18].
86 Ibid, at [179].
87 Ibid, at [79].
88 Ibid, at [12]-[18].
89 *Massachusetts v EPA* 127 S. Ct. 1438, 529.
90 *Kelsey Cascadia Rose Juliana et al. v. United States of America et al* (*Juliana et al v USA*) (2016) Case No. 6:15-cv-01517-TC.
91 *Friends of the Earth v Governor in Council et al.* 2009 FCA 297.
92 *ClientEarth v Secretary of State for the Environment, Food and Rural Affairs* [2016] EWHC 2740.
93 *Urgenda*, n76.

appropriate for domestic courts to play a role in government decision making about climate change policy.'[94]

Some Australian courts have also been more outward-looking and receptive in their treatment of IPCC assessments and climate science. They have largely presided over administrative law claims involving judicial review or merits review.[95] In Australia, such climate litigation is a subset of litigation geared towards the enforcement of Ecologically Sustainable Development (ESD) principles.[96] As a specialist environmental court made up of judges that possess a strong internationalist outlook, the New South Wales Land and Environment Court (LEC) has been a leader in climate adjudication in Australia and beyond. The LEC is a highly-informed domestic court which consciously develops its jurisprudence by drawing on a range of international and foreign legal material as well as other expert material.

In the 2007 *Taralga* case – and arguably one of the earliest Australian climate change lawsuits in which the Taralga community challenged a government proposal for a windfarm – Chief Judge Brian Preston delivered a judgment in which he extensively cited the then current IPCC Fourth Assessment Report (AR4).[97] He unequivocally

[94] *Thomson*, n85, at [101]-[133].
[95] Under Australian federal law, as well as New South Wales state law, ***merits review*** is a type of administrative review in which 'a person or body other than the original decision-maker reconsiders the facts, law and policy aspects of the original decision and determines what is the correct and preferable decision.' This is often described as 'stepping into the shoes' of the original decision-maker. Merits review can be undertaken by an administrative decision-maker, tribunal or judge depending on the requirements of the particular jurisdiction. Australian Review Council: Australian Government, 'What is merits review?' (2020) <https://www.meritprotectioncommission.gov.au/information-about-administrative-review/what-merits-review> accessed 6 February 2020.
[96] Justice Peter Biscoe, 'Climate Change Litigation' (11-14 November 2010) < http://www.lec.justice.nsw.gov.au/Documents/biscoe_climatechangelitigation.pdf> accessed 27 June 2019.
[97] *Taralga Landscape Guardians Inc. v Minister for Planning* (2007) 161 LGERA 1.

opined that 'IPCC assessments make clear that it is impossible to ignore the effects of human behaviour on climate change,' namely through the combustion and use of fossil fuels, which have increased the vulnerability of natural and human systems, 'threatening to compound the desperate situation in Australia's rural and drought-affected areas.'[98] IPCC AR4 significantly influenced his decision to rule in favour of the government's proposal for a wind farm, as indicated by his statement that the public benefits to be derived from the renewable energy scheme – GHG emissions mitigation in the long-term – far outweighed the short-term private costs to the Taralga community and landowners from the loss of polluting, emissions-intensive energy sources like coal power plants.[99]

As discussed in part III, the LEC and its judges are pioneers in judicial networking and have also had a significant transnational influence on environmental and climate adjudication, notably in the Asia-Pacific.[100] Furthermore, the LEC's procedures for dealing with scientific evidence in environmental cases are rigorous. Under NSW law, in order to be admissible, expert evidence must be: i) *relevant* in that it could directly or indirectly affect the probability of the existence of a fact in issue; ii) involve *specialised knowledge* within a field of knowledge the law recognises; iii) submitted by a witness who is *qualified as an expert* in the recognised field of specialised knowledge; and iv)

98 *Taralga*, n97, 10-11 at [67]-[71].
99 Ibid, 41, at [352].
100 For example, the NSW LEC has a partnership with the Supreme Court of Thailand. Thai judges have participated in capacity building and training workshops at the LEC and have drafted a legal framework on environmental adjudication and new draft rules on expert witnesses akin to those of the LEC. Brian J. Preston & Charlotte Hanson, 'The Globalisation and Harmonisation of Environmental Law: An Australian Perspective' (2013) 16 *Asia Pacific Journal of Environmental Law* 1, 29.

the expert opinion must be wholly or substantially based on specialised knowledge within the field.[101]

In an attempt to ensure that adjudication is based on the most reliable and up-to-date scientific evidence, the LEC convenes a concurrent evidence procedure known as the 'Joint Conference of Experts,' whereby environmental or climate scientists sit side by side, air their expert opinions including any disagreements and produce a joint report that is submitted to the court as evidence at trial.[102] An additional layer of scientific peer review and vetting is built into this pre-trial fact-finding process, with the intent that any junk science is filtered out and the scientific report that is produced is watertight and rarely rejected by the court.[103] This report is also arguably the quintessential embodiment of trans-science, as it is science that is tailor-made for resolving legal questions that arise in a given case. These LEC procedures therefore aptly illustrate the high level of science-law co-production that takes place between scientists and judges on environmental protection and climate change matters. It is also a prime example of a hybridised knowledge practice (i.e. one at the intersection of science and law) with norm-generative implications. The following sub-section also considers the LEC's evaluation and application of the IPCC's carbon budget framework.

ii. Post-Paris adjudication and the IPCC's 'carbon budget' framework: Shared interpretation of evidence and reasoning

[101] NSW Land and Environment Court, 'Experts and expert evidence' (2018) <http://www.lec.justice.nsw.gov.au/Pages/coming_to_the_court/expert_witnesses.aspx#Admissibility_of_exp> accessed 27 July 2018.
[102] *Evidence Act 1995* (NSW), s 79; See also Brian J. Preston, 'Science and the law' (2003) 23 *Australian Bar Review* 1, 3.
[103] B.J.Preston, Ibid.

The adoption of the Paris Agreement in 2015 and the IPCC's publication of its Special Report (SR15) [104] on global warming of 1.5°C in October 2018 are parallel legal and scientific developments in the climate change regime which have arguably ushered in a new, more science-responsive and science-oriented form of climate adjudication. The Paris Agreement's architecture of Nationally Determined Contributions (NDCs) envisages national institutions as the locus of climate change governance. Indeed, domestic courts have clearly emerged as the primary sites for the adjudication of legal disputes in which claimants have sought to challenge national governments for failing to meet agreed mitigation targets under the Paris Agreement, oriented towards the collective 1.5-2°C temperature stabilisation goal for warming above pre-industrial levels.[105] In several cases, courts have treated the Paris Agreement as a kind of *grundnorm* which provides vital interpretive context for the adjudication of domestic climate change disputes.[106] This wider interpretive context also encompasses IPCC assessments including AR5 and SR15. I have argued here that AR5 is the main climate science output that recurs throughout much post-Paris climate litigation. In addition, there are early signs that the closely connected SR15 is also gaining currency and judicial attention and is likely to be much more influential in future generations of climate litigation.

SR15 was produced to give concrete expression and content to the Paris Agreement's stipulated goal of "holding the increase in average global temperatures to well below

[104] IPCC, 'Global Warming of 1.5°C: Summary for Policy Makers' (SR15) (22 December 2018) < https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf> accessed 27 June 2019.
[105] *Urgenda,* n76; *Klimaatzaak,* n79*; Plan B Earth and Others v Secretary of State for Transport* [2019] EWHC 1070*; Thomson,* n85; *EarthLife Africa Johannesburg v Minister for Environmental Affairs and Others (Thabametsi Case*) Case No. 65662/16 (2016) <http://climatecasechart.com/non-us-case/4463/> accessed 27 June 2019.
[106] Anna-Julia Saiger, 'Domestic Courts and the Paris Agreement's Climate Goals: The Need for a Comparative Approach' (2020) 9 *Transnational Environmental Law* 1.

2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels."[107] The IPCC has expressed with a high level of confidence that "global warming is likely to reach 1.5°C between 2030 and 2052 if [GHG emissions] continue to increase at the current rate."[108] As the Paris Agreement does not specify the content of this temperature goal, the IPCC sought to do so through SR15 by expanding upon the concept of a global 'carbon budget' which was first outlined in AR5. In SR15, the IPCC outlines a carbon budget for both 50% and 66% scenarios for the avoidance of 1.5°C. By relying on global surface air temperature (SATs), the IPCC calculates that in relation to the 66% avoidance scenario, the global carbon budget is reduced from 570GtCO2 to 420GtCO2.[109]

It is crucial to note that these budgets are, at best, estimates based on currently available model datasets on observational temperature records from the UK Met Office's HadCrut4, NASA's Gistemp, NOAA's GlobalTemp, Cowtan and Way and Berkeley Earth. Therefore, as per the IPCC's own disclaimer, there are substantial uncertainties in the size of these estimated remaining carbon budgets.[110] The IPCC puts the uncertainty range at ±250GtCO2 based on the different estimates of historical temperatures.[111] For example, it is not yet known the extent to which these carbon budgets would be affected (i.e. reduced) by the release of non-CO2 GHGs and additional CO2 and methane from permafrost melt and wetlands over the course of this century.[112] Importantly, the IPCC concludes that to remain within and not overshoot these allotted

[107] SR15, n104, 9.
[108] Ibid, 6.
[109] Ibid, 14.
[110] Ibid.
[111] Ibid.
[112] Ibid.

carbon budgets and thereby avoid a 1.5°C temperature rise by mid-century requires states to pursue deep and dramatic global emissions reductions and a "rapid and far-reaching" restructure of our economies and industrial systems.[113]

In the *Gloucester Resources* case, the NSW Land and Environment Court was among the first to wrestle with and apply the carbon budget approach in the context of climate adjudication. The case involved a matter concerning a development application for a new open cut coalmine in the Gloucester Valley (NSW). Under section 4.15(1) of the NSW Environmental Planning and Assessment ('EPA') Act, the Independent Planning Commission (IPC) of NSW, on delegation from the NSW Minister for Planning, was required to consider the public interest when reviewing a development application.[114] The court upheld the Minister's refusal to grant authorisation to the applicant, a mining company known as Gloucester Resources Limited (GRL), for the development of an open-cut coalmine (the 'Rocky Hill' coalmine) in Gloucester Valley, NSW. This refusal of authorisation was partly based on the IPC's rational consideration of existing and future climate change impacts as an integral part of Ecologically Sustainable Development (ESD) principles. Other considerations which influenced the Minister's decision included the detrimental socio-economic and visual-aesthetic impacts the coalmine would likely have in relation to the Gloucester valley.

In an act of unequivocal deference to climate science, the Court emphasised the centrality and relevance of IPCC assessments and national assessments outlining current and future climate impacts applicable to Australia. These include *inter alia* increased

[113] SR15, n104, 17.
[114] See *Environmental Planning and Assessment Act 1979* (NSW).

average air surface temperature, increased heatwaves, harsher fire weather and increased bushfire events, ocean warming and acidification, an increase in the intensity and frequency of tropical cyclones and a decline in rainfall.[115] The Court also relied extensively and emphatically upon expert evidence provided by Earth Scientist Will Steffen to decipher the implications of opening new coalmines for Australia's NDC under the Paris Agreement (26-28% below 2005 levels by 2030) and its emissions allowances in light of the global carbon budget.

In his judgment, Justice Brian Preston adopted key parts of Steffen's report explaining how the carbon budget approach could be applied to the 2°C temperature target. Applying the IPCC's calculations for a greater than 66% avoidance scenario outlined above, Steffen stipulated that "the cumulative human emissions since 1870 must be less than 1000 Gt C (emitted as CO2)" which he terms the 'base budget' based on the IPCC's AR4.[116] Furthermore, Steffen concluded that subtracting non-CO2 GHGs (-210 Gt C) and historical emissions through to 2017 (-575 Gt C) leaves the remaining carbon budget to net zero emissions at 215 Gt C.[117] This means "the world has approximately 21-22 years at current emissions rates before the global economy must reach zero emissions."[118] Steffen put the year at which emissions must peak before declining at 2020.[119]

The crucial take away from this carbon budget calculus according to Steffen is that fossil fuel combustion must be phased out in the coming years, which necessitates that

115 *Gloucester Resources Ltd v Minister for Planning* (2019) 234 LGERA 257, at [436]-[438].
116 Ibid, at [441]-[443].
117 Ibid, at [443].
118 Ibid.
119 Ibid, at [444].

"existing oil and gas reserves remain in the ground, unburned if the Paris accord climate targets are to be met."[120] Applying this approach to Australia specifically, Steffen concluded that: i) most of Australia's fossil fuel reserves, and all of its coal reserves, must remain in the ground; ii) the development of new fossil fuel reserves is incompatible with any carbon budget premised on a more than 50% avoidance scenario and with Australia's NDC under the Paris Agreement; and iii) the approval and development of the Rocky Hill coalmine would therefore be "inconsistent with the carbon budget approach towards climate stabilisation."[121]

Justice Preston's judgment shows that the carbon budget approach and its synthesis by Steffen were particularly persuasive and compelling evidentiary drivers in this case, as they constituted major factors (along with adverse socio-economic, visual and aesthetic impacts of the proposed mine) that led the court to ultimately reject the applicant, GRL's, claim that the Rocky Hill coalmine should be one of the fossil fuel reserves exceptionally allowed to remain open to exploitation and combustion.[122] Particularly interesting is his conscious juxtaposition of the science-based carbon budget approach on the one hand and the scientifically-lacking or unsubstantiated claims on market substitution and carbon leakage presented by the defendants on the other, as determinative of the core issues. Justice Preston took specific notice of Steffen's statements on how any *new* fossil fuel developments would exceed the carbon budget, which he endorsed and applied to his own reasoning:

> From a scientific perspective, it matters not which fossil reserves are burned or not burned, only that, in total, most of the fossil fuel reserves are not burned. Professor Steffen

120 *Gloucester Resources*, n115, at [446].
121 Ibid, at [449].
122 Ibid, at [528]-[529].

> explained, however, that existing and already approved but not yet operational mines/wells will more than account for the fossil fuel reserves that can be exploited and burned and still remain within the carbon budget. This is the reason he considered that no new fossil fuel developments should be allowed.[123]

Crucially, Justice Preston remained unconvinced by the defendant's argument that the coalmine would 'not necessarily cause the carbon budget to be exceeded' and deemed it to be 'speculative and hypothetical' and not evidence-based.[124] He opined that there was no evidence before the court of any "specific and certain action to 'net out' the GHG emissions of the project" and therefore no authority could rationally give development consent in such a case.[125] This again clearly reflects the court's unequivocal prioritisation of and preference for claims which are built on a solid and rigorously tested scientific foundation and which accordingly provide a tangible and quantifiable basis for mitigation efforts.

The IPCC carbon budget was also applied by the The Hague Court of Appeal (COA) in *The Netherlands v Urgenda (Urgenda II)*.[126] The COA held that the Dutch state had done too little to prevent dangerous anthropogenic climate change, which is imminent and requires the adoption of more ambitious mitigation targets for 2020 and beyond as well as more immediate intervention.[127] The COA observed that:

> the later actions are taken to reduce [emissions], the quicker the available carbon budget will diminish, which in turn would require

123 *Gloucester Resources*, n115, at [527].
124 Ibid, at [530].
125 Ibid.
126 The Netherlands v Urgenda Foundation (Urgenda II) (The Hague Court of Appeal, 200.178.245/01, 9 October 2018) at [71].
127 Ibid.

> taking considerably more ambitious measures at a later stage, as is acknowledged by the State…to eventually achieve the desired level of 95% by 2020.[128]

Consideration of both IPCC AR5 and the carbon budget led the COA to uphold the Hague District Court's ruling that the Dutch State was required to adopt a minimum 25% emissions reduction target for 2020.[129] The COA also concluded that by failing to adopt such a target, The Netherlands had violated its duty of care to its citizens arising out of Articles 2 and 8 of the European Convention on Human Rights (ECHR).[130] The COA also rejected the Dutch State's contention that in absolute terms its emissions are minimal (i.e. a drop in the ocean) compared with global emissions.[131] In this regard, it held that the fact that climate change is a global problem does not exempt The Netherlands from "obligations to take measures within its own territory, within its capabilities, which in concert with the efforts of other states provide protection from the hazards of dangerous climate change."[132]

Similarly, in *The Netherlands v Urgenda (Urgenda III),* the Supreme Court of The Netherlands also applied the carbon budget to interpret the Dutch government's obligations under Articles 2 and 8 ECHR and held that there is limited space available in the carbon budget.[133] The Supreme Court acknowledged the IPCC scientific consensus that any delay in reducing emissions now would exhaust the available carbon budget and significantly increase the cost of pursuing emissions reductions later.[134] In

[128] *Urgenda II*, n126, at [71].
[129] Ibid, at [72].
[130] Ibid, at [72]-[73].
[131] Ibid, at [61]-[62].
[132] Ibid, at [62].
[133] *The Netherlands v Urgenda Foundation (Urgenda III)*(The Supreme Court of the Netherlands, 19/00135, 20 December 2019) at [4.6], [7.43].
[134] Ibid.

light of this, the Court held that the Dutch government had failed to show that its emissions reductions were sufficiently ambitious and capable of achieving the 2030 and 2050 targets as required by its obligations under Articles 2 and 8 ECHR.[135] It accordingly concluded that the COA had rightly ordered the Dutch State to increase its 2020 emissions reduction targets.[136]

The carbon budget was also applied by the Borgarting Court of Appeal in *Greenpeace Norway v Ministry of Petroleum and Energy*. At the outset, the Court acknowledged the IPCC's scientific consensus on the general causal link between anthropogenic GHG emissions and climate change.[137] In relation to the carbon budget, it established that there is only room for another fifteen years of emissions before the world needs to transition to net zero emissions.[138] Based on this carbon budget calculation, the Court found that Norwegian emissions per inhabitant are approximately 10 tonnes per year, which exceeds the global average of 5 tonnes per year as well as the EU average.[139] It also held that Norwegian emissions from oil and gas combustion amount to 1% of all global emissions, which is not insignificant.[140] The Court accordingly found that since drastic emissions reductions are required, Norway's reported NDC was insufficient for achieving the Paris Agreement's temperature goal. Thus, it held that the Norwegian government is required to progressively ratchet up its emissions reductions and its exploitation of new oil and gas reserves is directly anathema to these commitments.[141]

135 *Urgenda III*, n133, at [7.4.6].
136 Ibid, at [8.34]-[8.35].
137 *Greenpeace Norway v Ministry of Petroleum and Energy* (Borgarting Court of Appeal, No. 18-060499ASD-BORG/03, 23 January 2020) 24.
138 Ibid, 23, at [3.1].
139 Ibid, 24-25.
140 Ibid, 25.
141 Ibid, 27.

The co-productive merger of scientific facts and judicial statements in these cases is emblematic of the science-policy-law co-production and epistemic hybridity that now permeates climate litigation and adjudication. These cases aptly illustrate how cutting-edge climate science is increasingly being infused into judicial reasoning in climate change cases. While the global carbon budget approach is still in its infancy and not yet an integral part of standard adjudicatory practice, it is likely to gain significant traction through recurrent use by plaintiffs in new waves of post-Paris climate litigation and adjudication and compel courts around the world to engage with this scientific framework. Early signs of this trend include recent climate litigation against the UK government in which the ENGO, Plan B Earth, explicitly referred to the carbon budget approach in its judicial review application.[142] Plan B Earth pressed the Secretary of State to consider revising the UK's 2050 carbon budget following the adoption of the Paris Agreement, its revised temperature goal of 1.5°C and the publication of the IPCC's special report, arguing they were statutorily obliged to do so.[143]

Similarly, the claimants in the '*People's Climate Case'* (*Carvalho v The European Parliament and the Council*) have relied heavily on the IPCC carbon budget, thereby providing another opening for a major regional court, the European Court of Justice (ECJ), to directly consider IPCC climate science. The case has been brought by ten families and the Swedish Saami Youth Association to compel the European Union (EU) to adopt more ambitious emissions reduction targets in line with the Paris Agreement. Applying the IPCC's carbon budget framework, the claimants have calculated the EU's

[142] *Plan B Earth and Others v Secretary of State for Business, Energy and Industrial Strategy* [2018] EWHC 1892 (Points of Claim), at [30].
[143] Ibid, 3-4.

remaining carbon budget and argue that it has already been exceeded.[144] It remains to be seen whether these claims will be accepted by the ECJ on appeal. This case is discussed in more detail in Chapter Six in the context of litigants' application of the IPCC carbon budget framework.

Locally situated, globally connected: Climate adjudication as scalar challenge

The sum of these networked and structurally analogous adjudicative exercises is an incipient body of shared climate change case law and precedent, which reflects a largely convergent and cohesive transnational judicial outlook on the role and status of climate science in climate litigation. At the heart of this is the judicial recognition of climate change as a concurrently global, regional, national and local (i.e. multi-scalar) problem that demands a multi-level and transnational governance response.[145] One side-effect of locally-situated, albeit globally-attuned adjudication of the kind discussed in this chapter is arguably that IPCC assessments are always admissible in climate change cases. The cases explored here reveal a tacit admission by judges around the world that all peer reviewed and up-to-date physical science on climate – both individual studies and their synthesis in the form of IPCC assessments – is potentially relevant and admissible in relation to evidentiary enquiries (including causation) in any given climate change case.

In short, through such judicial interventions and mediations, IPCC assessments are being integrated into the factual record of many domestic climate change cases. This development radically challenges and disrupts traditional rules of evidence and

[144] *Armando Carvalho and Others v EU* (European General Court, T-330/18, complaint filed 24 May 2018) < https://peoplesclimatecase.caneurope.org/wp-content/uploads/2018/08/application-delivered-to-european-general-court.pdf> accessed 13 August 2020, at [268]-[274].
[145] Hari M. Osofsky, 'Is Climate Change 'International'? Litigation's Diagonal Regulatory Role' (2009) 49 *Virginia Journal of International Law* 3, 587.

procedure oriented towards factual specificity (particularly causation enquiries) of the kind explored in Chapter Four on US courts. It is also consistent with Fisher, Scotford and Barritt's broader observation that "climate change may be thought of as legally disruptive in that it requires a 'break' in the continuity of existing legal practices and doctrinal 'business and usual.'"[146] This disruption is also characterised by courts showing an increased willingness to adjudicate localised climate change disputes or claims routinely by reference to global bodies of science such as IPCC reports and new scientific developments in the IPCC, such as the expanded 'carbon budget' approach articulated in SR15, as exemplified by *Gloucester Resources*, the *Urgenda* appeal cases and *Greenpeace Norway*. This science-driven approach arguably goes beyond the conventions and boundaries of traditional environmental adjudication into a new conceptual space marked by science-law co-production, transdisciplinarity and hybridised epistemic activity.

In this crucial aspect, there appears to be a kind of structural isonomy between scientific and legal evidentiary procedures pertaining to climate change. Like the IPCC, courts are always grappling with multiple scales whenever they preside over a climate change claim. What is unique in the context of climate litigation and adjudication is that the 'global' is always simultaneously implicated in local disputes, since climate change is inherently a multi-scalar problem. Judges of the NSW LEC have repeatedly acknowledged the interrelationship between the global and local in the context of climate change, with Justice Pain noting the following with respect to the proposed Anvil Hill coalmine development in *Gray v Minister for Planning*:

[146] Elizabeth Fisher, Eloise Scotford & Emily Barritt, 'The Legally Disruptive Nature of Climate Change' (2017) 80 *Modern Law Review* 2, 174.

> The fact that there are multiple contributors to climate change globally does not mean that a single large source such as the Anvil Hill Project in the context of NSW should be ignored in the environmental assessment process. The coal intended to be mined is clearly a potential major single contributor to GHG emissions deriving from NSW given the large size of the proposed mine. The impact from burning the coal will be experienced globally as well as in NSW, but in a way that is not currently able to be accurately measured, does not suggest that the link in causation of an environmental impact is insufficient.[147]

This statement was cited with approval by Justice Preston in *Gloucester Resources* in support of his observation that "many courts around the world have recognised that climate change is caused by a myriad of individual sources, each proportionally small relative to the global total of GHG emissions, and will be solved by abatement of GHG emissions from these myriad individual sources."[148] The epistemic-evidentiary foundation for all climate change claims is therefore universal and identical. Furthermore, the multi-scalar approach increasingly adopted by courts in climate adjudication is largely consistent with the NDC architecture of the Paris Agreement, which envisages and encourages cross-level interaction and coordination across different tiers of climate change governance. It also serves as further evidence of judges' self-understanding of their role as transnational institutions in climate change governance.

147 *Gray v Minister for Planning* (2006) 152 LGERA 258, at [98].
148 *Gloucester Resources*, n115, at [518].

V. Conclusion

This chapter has argued that judicial interventions are a key node in the process of transforming IPCC assessments into a shared transnational evidence base for climate litigation and adjudication as well as policymaking and regulation on climate change. It has shown that through networked interactions and the innovative application of scientific knowledge in climate adjudication contexts, national courts are co-producing a shared body of transnational case law or jurisprudence on climate change. This is largely representative of a model of *science-policy-law co-production*. Transnational judicial networking initiatives like the GJIE and the convergent judicial evaluation, interpretation and application of IPCC assessments in domestic courtrooms are transformative processes out of which this new body of shared climate change case law is emerging. This judicially co-produced body of climate change case law can alternatively be thought of as a 'common law of climate change.' Moreover, climate science constitutes the epistemic core of this emergent body of transnational climate change case law. Both climate change jurisprudence and transnational judicial conversations have also encouraged the standardisation of evidence-based policymaking as best practice in domestic climate change regulation.

Climate adjudication around the world is firmly undergirded by a transnational judicial consensus on IPCC assessments as a minimum baseline for climate change regulation and policymaking. The transnationalisation of climate change case law or jurisprudence has intensified outside the US through the recurrent judicial evaluation, interpretation and creative application of climate science, with activist-internationalist courts in Europe and Australasia leading such efforts. These courts have shown themselves to be

more receptive and willing to adjudicate claims backed by cutting edge climate science (IPCC AR5) and new scientific developments such as the IPCC's global carbon budget approach (IPCC SR15). More importantly, the adjudication of local disputes by reference to global bodies of climate science reflects a deeper judicial consciousness or heightened awareness that courts are more than just domestic institutions; rather they have become key players in transnational climate change governance. This chapter has shown that climate change jurisprudence is peppered with instances of courts both consciously and unconsciously embracing their transnational functions. The science-law interface – as embodied by networked interactions between the IPCC, climate scientists and judges – involves these actors transcending strict disciplinary boundaries to create a new conceptual and transdisciplinary space involving *science-policy-law co-production* in which hybridised knowledge work has become normalised. This dynamic is generative of a new and co-produced body of transnational climate change case law in the post-Paris era.

CHAPTER SIX

Litigant Networks and the Transnationalisation of Climate Law

We are not very good at telling stories about a hundred people doing things or considering that the qualities that matter in saving a valley or changing the world are mostly not physical courage and violent clashes but the ability to coordinate and inspire and connect with lots of other people and create stories about what could be and how we get there…Positive social change results mostly from connecting more deeply to the people around you than rising above them, from coordinated rather than solo action.[1]

Rebecca Solnit

I. Introduction

In this PhD project, I argue that climate science is being generated through transdisciplinary co-production between the domains of science, policy and law and the key actors steering this process include climate scientists, domestic courts and climate litigants. The byproduct of these co-productive dynamics is an emergent transnational and shared body of legal practice and jurisprudence on climate change, as illustrated in Chapter Five and this chapter. The rising environmental and human cost of climate change has accelerated the growth of climate litigation in recent years, with the lion's share of lawsuits being filed against governments and corporations by networks of private citizens, municipal governments and NGOs which constitute the largest class of plaintiffs.[2] In this chapter, I specifically argue that a major side-effect of such civil society-driven litigation has been the transnationalisation of climate change governance

[1] Rebecca Solnit, 'When the Hero is the Problem' (2019) < https://lithub.com/rebecca-solnit-when-the-hero-is-the-problem/?fbclid=IwAR1TVkwBspKavVUcmPS57bTp7fbWv2WEoqhW1yvzObiegE9RWAZQHebrLbQ> accessed 25 April 2019.

[2] Out of a sample of 201 climate change lawsuits studied by Markell and Ruhl, NGOs appeared as plaintiffs in almost three-quarters of all cases. See David Markell & J.B. Ruhl, 'An Empirical Survey of Climate Change Litigation in the United States' (2010) 40 *Environmental Law Review* 7, 10647.

and the emergence of a new corpus of transnational legal practice and jurisprudence on climate change that increasingly resembles what I call '*a legal commons on climate change*.'[3] Recent civil society and NGO advocacy efforts have precipitated a 'wave' of climate litigation around the world, with *Urgenda v The Netherlands* marking its zenith and the beginning of a new more promising phase.[4] This chapter begins from the premise that networked modes of climate litigation, spearheaded by private citizens and the NGOs that typically represent them, have become important new drivers of climate change regulation and governance. I specifically argue here that alongside the IPCC (Chapter Three) and courts (Chapters Four and Five), these litigants are also participating in the co-production of a new body of transnational climate change legal practice and jurisprudence based on a shared commitment to and affirmation of a particular scientific-factual account of climate change.

First, the science being used in most climate change litigation is common and in some cases deployed in argumentatively similar ways and, at a minimum, comprises IPCC and similar scientific assessments. Litigants are accepting and using the IPCC's technoscientific account of climate change, but are also making their own contributions to this account by crafting endangerment narratives and arguments about collective and proportional responsibility. These are also increasingly being combined with the imperatives of securing climate justice and protecting human rights pursuant to domestic

[3] Lord Carnwath has talked more broadly about a 'common law of the environment.' Lord Carnwath, 'Judges and the Common Laws of the Environment – at Home and Abroad' (2014) 26 *Journal of Environmental Law* 177, 187.

[4] Jacqueline Peel & Hari M. Osofsky, 'A Rights Turn in Climate Change Litigation?' (2017) 7 *Transnational Environmental Law* 1; Josephine van Zeben, 'Establishing a Governmental Duty of Care for Climate Change Mitigation: Will *Urgenda* Turn the Tide?' (2015) 4 *Transnational Environmental Law* 2; Geetanjali Ganguly, Joana Setzer & Veerle Heyvaert, 'If At First You Don't Succeed: Suing Corporations for Climate Change' (2018) 38 *Oxford Journal of Legal Studies* 4; John Schwartz, 'Students, Cities and States Take Climate Fight to Court,' *New York Times* (10 August 2018) < https://www.nytimes.com/2017/08/10/climate/climate-change-lawsuits-courts.html> accessed 15 August 2018.

law and national constitutions. Second, there is a high degree of overlap and structural similarity between these cases in terms of legal argumentation – a trend exemplified by NGO-driven public interest climate litigation. The prototypical examples in this regard include *Urgenda v The Netherlands* and *Juliana et al v USA*, which have inspired analogous pro-regulatory climate litigation in jurisdictions around the world.

This chapter examines NGO-led climate change lawsuits against both governments and corporations, which highlight how NGO litigants are using IPCC assessments and event attribution science to advance pro-regulatory agendas[5] and co-produce a shared body of transnational climate change case law. The analytical focus is on public interest lawsuits filed by NGOs on behalf of citizens against governments and corporations, with rights claims and the public trust doctrine at their epicentre,[6] as these lawsuits provide among the best illustrations of how litigants are engaged in the *science-law co-production* of transnational climate change case law.

Part II considers the 'framing power' of NGOs in climate change governance[7] and its formative role in the transnationalisation of NGO-climate litigant networks. Parts III and IV argue that the emergence of a shared transnational body of case law and jurisprudence on climate change is borne out by the striking structural similarities between climate change lawsuits around the world, particularly recurrent patterns of

5 Pro-regulatory lawsuits are those which seek to hold defendants (e.g. governments and corporations) accountable in accordance with a state's existing environmental and climate change laws and policies and/or compel the state's adoption of new domestic laws and policies pertaining to climate change mitigation and adaptation in accordance with a state's international obligations under the UNFCCC regime (i.e. the Paris Agreement).

6 John Schwartz, 'In a Novel Tactic on Climate Change, Citizens Sue Their Governments,' *New York Times* (2016) <http://www.nytimes.com/2016/05/11/science/climate-change-citizen-lawsuits.html?_r=0> accessed 12 May 2016.

7 Jen Iris Allan & Jennifer Hadden, 'Exploring the framing power of NGOs in global climate politics' (2017) 26 *Environmental Politics* 4.

legal argumentation based on litigants' mobilisation of IPCC climate science. Part III discusses litigants' use of IPCC assessments and event attribution science to construct endangerment narratives, which constitute a recurrent and unifying thread in climate change lawsuits. Part IV considers administrative lawsuits in common law jurisdictions which are resulting in the standardisation of climate impact assessments in environmental decision-making. These cognate parallel processes represent an indirect form of cross-fertilisation. Part V then focuses on the direct cross-fertilisation of litigants' legal claims and argumentation (i.e. reliance upon foreign cases) anchored in IPCC climate science, with an emphasis on what I term youth-driven '*future generation lawsuits*' comprising human rights and public trust claims. I argue that the sum of these processes is generative of a new and distinctly transnational space within which a shared body of climate change case law – one that closely resembles Waldron's idea of a modern *ius gentium*[8] - is emerging and taking shape. Part V presents some concluding observations.

II. Transnational NGO-Litigant Networks

The transnationalisation of NGO networks through climate litigation

Transnational climate litigation is both a cause and a consequence of the transnationalisation of NGO networks. The NGO climate movement has gained significant momentum since COP-21. It is argued here that climate litigation marks an important arena in which NGO networks have made crucial gains with a discernible pro-regulatory impact. The growth of NGO-driven climate litigation globally in recent years has reinforced and catalysed the transnationalisation of climate change law and

[8] Jeremy Waldron, 'Foreign Law and the Modern *Ius Gentium*' (2005) 119 *Harvard Law Review* 1.

jurisprudence. At its core, the rise of NGO networks and civil society is a symptom of globalisation, the spread of transnational modes of governance and the growth of transboundary environmental problems due to runaway neoliberal and fossil fuel capitalism.[9] In addition, the global institutional architecture of environmental governance (e.g. UNEP, UNFCCC COPs etc.) fosters and encourages transnational modes of interaction, dialogue and cooperation among NGOs and other civil society actors.[10]Seen against this backdrop, the filing of lawsuits by NGOs against multinational fossil fuel corporations in a range of jurisdictions constitutes a conscious and coordinated forum-shopping strategy to hold the latter accountable. For example, *Lliuya v RWE* aptly illustrates this transnational dynamic with a claimant in Peru backed by the German ENGO, Germanwatch, suing a German power company in its own jurisdiction for climate-related damages. Moreover, this turn to private litigation against corporations is consistent with the transnationalisation of climate change governance writ large.[11] The absence of political will at the nation-state level to regulate the fossil fuel industry by, for example, removing subsidies or imposing a carbon tax, has compelled NGOs to sue fossil fuel companies in more receptive jurisdictions like California,[12] Germany[13] and the Philippines,[14] with a view towards securing adaptation assistance for climate change-affected communities and driving remedial legislative and regulatory reform.

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[9] James Rosenau, 'Governance and Democracy in a Globalizing World' in Daniel Archibugi et al (eds), *Re-imagining Political Community: Studies in Cosmopolitan Democracy* (Stanford University Press 1998) 42.

[10] Robert Rohrschneider & Russell J. Dalton, 'A Global Network? Transnational Cooperation Among Environmental Groups' (2002) 64 *The Journal of Politics* 2, 514.

[11] G.Ganguly et al., n4, 845-846.

[12] *City of Oakland v B.P. et al* a No. C 17-06011 WHA, Order Granting Motion to Dismiss (25 June 2018) at 10.

[13] *Saul Luciano Lliuya v RWE* (2017) 20171130 Case No-2-O-28515.

[14] *Greenpeace Southeast Asia and Others v Carbon Majors* No CHR-NI-2016-0001 (2015) *Greenpeace.org* < http://www.greenpeace.org/seasia/ph/PageFiles/735291/CC%20HR%20Petition_public%20version.pdf> accessed 25 February 2019.

As prominent actors in global governance, NGOs have traditionally been more responsive to transboundary environmental problems and are "more likely to engage in international activity because they may find it necessary to look beyond their national borders for allies who support their principles."[15] Indeed, empirical studies have confirmed a high level of interaction between ENGOs across national boundaries in this century.[16] They have also observed that the processes through which ENGO networks are transnationalising typically comprise the international exchange of information, the coordination of activities, participation in international conferences and dealing with an international agenda.[17]

Rohrschneider and Dalton observe that when surveyed about their cross-border interactions, most ENGOs throughout North America, Europe, Latin America, Asia and the Pacific reported that they routinely and actively exchange information and coordinate their activities with their counterparts in other countries.[18] Among these, Northern (i.e. North American, Western European and Australasian) NGOs were more likely to be suppliers rather than recipients of technical and financial assistance.[19] The study also concludes that when ENGOs view an environmental problem as a predominantly international issue 'such as global warming,' they actively prioritise and pursue transnational modes of cooperation to address the problem.[20] Transnational ENGO activity was also found to be more vigorous in countries that have had a major

[15] R.Rohrschneider et al., n10, 516.
[16] Ibid, 519; Marissa A. Pagnani, 'Environmental NGOs and the Fate of the Traditional Nation-State' (2003) 15 *Georgetown International Environmental Law Review* 4.
[17] R.Rohrschneider et al., n10, 519.
[18] Ibid.
[19] Ibid, 520.
[20] Ibid, 521, 526.

hand in creating the international environmental law regime.[21] Finally, ENGOs like Greenpeace which first achieved prominence domestically[22] have tended to be more internationally active, which lends some credibility to the view that 'transnational activism is an extension of domestic politics.'[23]

While empirical observations mainly pertain to ENGOs and their role in global environmental governance, I argue that these distinctly transnational modes of NGO interaction have accelerated and remain highly visible in the sphere of climate change governance. For example, the Climate Action Network (CAN), possibly the largest transnational NGO network on climate change, declares that its vast membership of 1300 NGOs across 120 countries works towards the goal of:

> limiting human-induced climate change to ecologically sustainable levels…through information exchange and the coordinated development of NGO strategy on international, regional, and national climate issues…[with] regional network hubs that coordinate these efforts around the world.[24]

Transnational NGO networks occupy a position of central importance and influence within the global climate change movement and have stepped up their transnational activism with the intent of transforming national climate policies in line with IPCC

[21] R.Rohrschneider et al., n10, 523.
[22] Greenpeace was founded in 1971 in Vancouver, Canada by environmental activists Irving and Dorothy Stowe. It has offices in over 40 countries and an international coordinating office in Amsterdam. Marc Montgomery, 'The Canadian Origins of Greenpeace' (2015) <http://www.rcinet.ca/en/2015/09/16/history-sept-15-1971-the-canadian-origins-of-greenpeace/> accessed 2 April 2019; Greenpeace, 'Our History,' (2019) < https://www.greenpeace.org.uk/about/impact/history/> accessed 2 April 2019.
[23] R.Rohrschneider et al., n10, 526.
[24] Climate Action Network, 'About CAN' (2019) < http://climatenetwork.org/about/about-can> accessed 1 April 2019.

climate science and the Paris Agreement. Firstly, the work of the IPCC and marked advancements in climate science have furnished ENGOs with a compelling and cohesive rationale and impetus for their activities around climate change. Traditional NGO lobbying efforts at UNFCCC COPs have typically yielded mixed results, often delivering only superficial or symbolic victories. Now armed with cutting edge scientific knowledge on climate change, these same ENGO networks continue to consolidate and extend themselves into the arena of climate litigation where they have fared better and even occasionally prospered.[25]

Secondly, as a universally accredited basis for national climate action, the Paris Agreement has also provided NGOs with a robust foundation for climate change advocacy and litigation. As will be documented below and in subsequent sections, recent climate change lawsuits signify the emergence of an increasingly shared ethos among NGOs on climate action and a common outlook on the benefits of strategically deploying litigation as an accountability mechanism. In sum, science and law have provided a powerful shared vocabulary for NGOs to articulate climate change claims in courts around the world on behalf of the citizens and constituencies they represent. Indeed, CAN Europe's extensive support for a recent public interest climate change lawsuit brought by citizens from ten countries against the European Union[26] attests to

[25] See *Stichting Urgenda v. Government of the Netherlands (Ministry of Infrastructure and the Environment), ECLI:NL:RBDHA:2015:7145,* Rechtbank Den Haag, C/09/456689/HA ZA 13-1396*; Saul Luciano Lliuya v RWE* (2017) <http://www.lse.ac.uk/GranthamInstitute/litigation/lliuya-v-rwe/> accessed 21 August 2017.

[26] In *The People's Climate Case*, the plaintiffs have challenged the EU's 2030 emissions reduction target, arguing that it should adopt a more ambitious target to protect their fundamental rights. See *Armando Carvalho and Others v EU* (European General Court, T-330/18, complaint filed 24 May 2018) < https://peoplesclimatecase.caneurope.org/wp-content/uploads/2018/08/application-delivered-to-european-general-court.pdf> accessed 16 May 2020.

the fact that litigation is being consciously promoted by NGOs as a mainstream strategy and another form of direct action on climate change.

The ENGOs ClientEarth and Greenpeace have arguably emerged as global leaders in this area. Since 2015, Greenpeace has filed a plethora of climate change lawsuits in several countries including Canada, Norway, Germany, France, the Philippines, Indonesia and the UK.[27] In some of these lawsuits, Greenpeace has received strategic and advisory support or been joined as a plaintiff by other prominent ENGOs like ClientEarth, Oxfam and Friends of the Earth.[28] These ENGOs are increasingly coordinating their activities and advocacy strategies on climate change around the world. For example, in a case filed by Greenpeace Belgium against the Flemish regional government for illegal levels of air pollution in violation of an EU Air Quality Directive, ClientEarth provided strategic advice in support of Greenpeace's legal claims.[29] Similarly, ClientEarth again collaborated with Greenpeace Greece to challenge environmental permits issued for the continuing operation of two lignite-fired power plants, Meliti I and II, emissions from which are expected to have significant adverse environmental impacts on Macedonia, Bulgaria and Albania.[30]

[27] See Grantham Research Institute on Climate Change and the Environment (LSE), 'Climate Change Laws of the World: Litigation' (2019) < http://www.lse.ac.uk/GranthamInstitute/climate-change-laws-of-the-world/> accessed 27 March 2019.
[28] See *Greenpeace and Others v UK (Heathrow Airport Expansion Lawsuits)* (2019) <https://storage.googleapis.com/gpuk-old-wp-site/wp-content/uploads/2017/10/case-against-heathrow-expansion.pdf> accessed 1 April 2019*;* Isabella Kaminski, 'UK court hears climate challenge to Heathrow airport expansion,' *Climate Liability News* (19 March 2019) <https://www.climateliabilitynews.org/2019/03/19/heathrow-expansion-climate-change-third-runway/> accessed 1 April 2019.
[29] ClientEarth, 'ClientEarth Litigation Summary: October-December 2018,' (2018) < https://www.clientearth.org/clientearth-litigation-summary-october-december-2018/> accessed 20 June 2019.
[30] Ibid.

Furthermore, Greenpeace and Oxfam have collectively sued both the UK and French governments for failing to take adequate action on climate change in violation of both EU climate change directives and domestic laws.[31] In the French lawsuit filed at the Administrative Court in Paris in March 2019, Greenpeace and Oxfam have argued in a manner similar to Urgenda that the French government is failing in its duty to reduce emissions and limit global temperature rise to 2°C below pre-industrial levels.[32] They have also put forward supporting evidence that documents an increase in French emissions.[33] In the same month, Greenpeace, Oxfam and Friends of the Earth also filed parallel lawsuits against the UK government for its proposed construction of a third runway at Heathrow Airport. Greenpeace has challenged the development on the grounds of noise pollution, biodiversity loss and public nuisance.[34] Oxfam, Friends of the Earth and the UK ENGO Plan B Earth have additionally argued that the government's Aviation National Policy Statement (ANPS) which approves the project is unlawful as it fails to consider domestic GHG emissions reduction targets under the UK Climate Change Act (2008), the Paris Agreement and IPCC reports.[35]

These lawsuits were filed in quick succession in March 2019 and paralleled the growing public momentum and pressure on governments to pursue meaningful climate action, as reflected by the youth climate strikes in the same month in over a hundred countries.[36]

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31 Sarah Elzas, 'French NGOs sue government for climate inaction' (14 March 2019) <http://en.rfi.fr/environment/20190314-french-ngos-sue-government-not-doing-enough-curb-climate-change> accessed 27 March 2019.
32 Karen Savage, 'French government sued for inadequate climate action,' *Climate Liability News* (14 March 2019) <https://www.climateliabilitynews.org/2019/03/14/france-government-sued-climate-greenpeace-oxfam/> accessed 28 March 2019.
33 S.Elzas, n31.
34 *Greenpeace & Ors v UK (Heathrow Airport Expansion Lawsuits)*, n28.
35 Ibid.
36 Sandra Laville, Matthew Taylor & Daniel Hurst, 'It's our time to rise up: youth climate strikes held in 100 countries,' *The Guardian* (2019) < https://www.theguardian.com/environment/2019/mar/15/its-our-time-to-rise-up-youth-climate-strikes-held-in-100-countries> accessed 27 March 2019.

In addition, the French lawsuit also garnered public support via a petition signed by 2000 French citizens.[37] While it is difficult to conclusively demonstrate a causal connection between these developments, it can be plausibly inferred that these lawsuits are at least partly motivated by growing public antipathy and moral outrage towards governmental procrastination on climate change. Such public disenchantment is widespread and beginning to serve as a prime catalyst for newer generations of NGO-led climate litigation. The post-*Urgenda* and post-Paris wave of climate litigation since 2015 is therefore distinctive relative to previous generations because NGOs have become the main receptacles through which public outrage towards deficient climate governance is expressed and translated into legal action.

NGO networks' science-based co-production of climate change case law

Overall, the transnationalisation of NGO networks has been enabled by significant advancements in both climate science and climate litigation in recent years. Firstly, as the scientific terrain on climate change has shifted considerably since 2014 (as reflected in IPCC AR5, the IPCC Special Report (2018) and a new body of attribution science on extreme weather events), NGOs have assumed a new function as global ambassadors and leading exponents of climate science. Litigation has become their strategic weapon of choice to compel governments to adopt sound, science-based climate change policies. As one spokesperson for the NGOs in *Greenpeace et al v France* noted, "acting through justice, through a lawsuit is a new means, which is absolutely necessary considering the climate emergency we are in."[38] In Chapter Two, I demonstrate that IPCC reports represent a synthesis of climate science specifically designed to be policy relevant and

[37] Laville et al, n36.
[38] See S.Elzas, n31.

intended as an aid for governments when designing and adopting climate change policies. I also problematise assumptions about the 'pure' nature of climate science and subsequently make the case for its concurrent recognition as a body of applied science and trans-science. Thus, in keeping with this characterisation, I argue here that, beyond its traditional policy demands and uses, NGO-driven climate litigation has become a new and discrete source of demand for the production of new climate science. Furthermore, NGOs are integrating new IPCC climate science such as SR15 and event attribution studies into their legal claims in order to lobby for science-based regulatory action. In doing so, they are engaging in the *science-law co-production* of an incipient body of shared transnational climate change case law in the post-Paris era. This dynamic is illustrated in further detail below in Parts III and IV.

Secondly, by repeatedly invoking and applying science in litigation around the world, NGOs are contributing to the transformation of both climate science and climate law. Although conventionally used to describe mainly domestic or intergovernmental scientific bodies like the IPCC, the concept of 'boundary organisation'[39] has been expanded to include "institutional attempts to govern expertise, stabilise differences and assign responsibilities."[40] It therefore has pertinent applications in relation to the range of knowledge-based lobbying and advocacy activities carried out by ENGO networks and their litigious efforts to hold governments and corporations accountable. Like the IPCC, ENGOs are also increasingly functioning as boundary or 'hybrid management'

[39] David H. Guston, "Boundary Organizations in Environmental Policy and Science: An Introduction" (2001) 26 *Science, Technology & Human Values* 4, 399.
[40] Karin M. Gustafsson & Rolf Lidskog, 'Boundary organizations and environmental governance: performance, institutional design, and conceptual development' (2018) 11 *Climate Risk Management* 1, 5.

organisations[41] in climate change governance because they are also deeply involved in processes of knowledge vetting, synthesis and dissemination which have the potential to influence and shape public policy. Their strategic deployment of IPCC climate science in climate litigation (documented in Parts III and IV below) means that they also sit alongside the IPCC and domestic courts as co-producers of an emerging transnational climate change case law.

Climate litigation elucidates this dynamic as ENGOs now fluidly operate across the worlds of science, law and policy. They are also a kind of boundary or 'hybrid management' organisation as they are mediating and facilitating interactions *between* the climate science community and courts. In what Miller refers to as 'cross-domain orchestration' that is symptomatic of hybrid management[42] previously discussed in Chapter Three, ENGOs are transmitting and translating scientific knowledge into legal and policy settings. Their strategic fusion of science and law is generating a distinct body of hybridised climate change case law. The key products or 'boundary objects'[43] emerging out of this synthesis include what I call *endangerment narratives*, new arguments on collective and proportional responsibility based on the market share theory, the standardised climate change impact or risk assessment and an entirely new

[41] In Chapter Two, I outline how Clark Miller's notion of 'hybrid management' expands and updates David Guston's concept of the boundary organisation. Miller's more expansive and flexible terminology is relied upon here as it more apt for describing the range of knowledge activities being carried out by climate scientists and NGOs in climate litigation scenarios. Clark Miller, 'Hybrid Management: Boundary Organizations, Science Policy, and Environmental Governance in the Climate Regime' (2001) 26 *Science, Technology & Human Values* 4, 492.

[42] Ibid, 492.

[43] As discussed in Chapter Two, Star and Griesemer employ the term boundary objects to refer to "relatively stable and reproducible things, people, projects, texts, maps, and ideas that facilitate articulation between different actors and social worlds" and satisfy the informational requirements of each of them. These boundary objects often flow through allied knowledge networks between scientists and non-scientists. Susan Leigh Star & James R. Griesemer, 'Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology' (1989) 19 *Social Studies of Science* 3, 393, 408.

genre of climate litigation which I term the *future generation lawsuit*. These are constitutive components of an incipient shared transnational climate change jurisprudence. NGO-driven climate litigation therefore aptly showcases the ways in which climate science and law have become mutually constitutive and reinforcing.

The framing power of NGOs

The role of NGOs in international climate change negotiations is well-documented. ENGO efforts at early UNFCCC COPs indicate that the use of expert evidence, including climate science, to shape both public and international political discourse on climate change is indeed a long-standing and well-established practice among ENGOs and global civil society. This 'framing power' of NGOs in global climate politics partially explains the inclusion of a provision on loss and damage in the Paris Agreement.[44] I argue that over the past decade NGOs have adopted and fine-tuned a strategy of using technoscientific framings of climate change in a novel, and more contextualised way than before. This 'framing power' lies at the heart of their co-productive contributions to climate litigation and the development of a new body of transnational climate change case law.

While mobilising a technoscientific framing of climate change derailed earlier NGO efforts to influence outcomes at the Kyoto Protocol negotiations and subsequent COPs like Copenhagen, Allan and Hadden contend that NGOs expanded their influence and made significant gains in the lead up to COP-21 in Paris because they had shifted the discursive terrain on climate change more explicitly towards a 'justice framing.'[45] The

[44] J.I.Allan et al., n7, 600; Michael Jacobs, 'High pressure for low emissions: How civil society created the Paris climate agreement' (2016) 22 *Juncture* 4, 600.
[45] M.Jacobs, Ibid, 606.

proliferation of NGO-driven climate justice framings after COP-15 in Copenhagen proved essential for the mobilisation of global public opinion and sympathy in favour of climate action. Allan and Hadden argue that the 'justice framing' of climate change superseded previous technoscientific framings of the problem.

While true for its time, I argue that the binary between 'justice' and 'technoscientific' framings of climate change appears increasingly superficial and dated in contemporary climate politics in light of the rapidly changing role and influence of civil society. Rather, recent waves of climate litigation strongly indicate that these two seemingly disparate and oppositional framings of climate change have become deeply enmeshed, with NGOs using both in a complementary and mutually reinforcing manner before courts, as will be discussed below in Parts III and IV. In addition to lobbying governments in international climate negotiations, NGOs also engage in research, advocacy and outreach[46] and are increasingly resorting to adversarial tactics such as litigation to hold governments and corporations accountable for climate change in accordance with their commitments under the Paris Agreement. Knowledge production and litigation have become important frontline tactics in the long-term NGO strategy with respect to climate action in the last decade, as exemplified by landmark climate litigation in *Urgenda v The Netherlands* and *Juliana v USA.* The sum of these processes has led academic commentators to plausibly argue that 'a new climate politics' is ascendant.[47]

[46] Michelle M. Betsill & Elisabeth Correll, *NGO Diplomacy: The Influence of Nongovernmental Organizations in International Environmental Negotiations* (MIT Press 2008) 2.
[47] M.Jacobs, n44, 322.

The contribution of NGO networks to climate change advocacy and litigation have been fourfold. Firstly, by resorting to the language of rights, NGOs have cast a spotlight on climate change not only as a scientifically-proven phenomenon as per the work of the IPCC, but also fundamentally an issue of global inequity and social justice.[48] In doing so, they have laid the groundwork for explicitly linking 'so-called social struggles with those we call ecological.'[49] Their lobbying efforts in the post-Copenhagen era have served to ensure that climate change has achieved a stranglehold on the public imagination as a problem inextricably bound up with questions of inequality, development, poverty, justice and rights.

Secondly, NGOs like Greenpeace and Bill McKibben's 350.org as well as NGO coalitions like the Climate Action Network (CAN) have been instrumental to the work of the IPCC as expert advisers and 'provide the legitimacy of inclusiveness needed for the epistemic coalition to have sufficient authority.'[50] They do so by bringing together climate scientists through the commissioning of expert reports and employing scientific methods and arguments to convey their message.[51]

Thirdly, an important contribution of NGOs to epistemic processes on climate change has been to encourage debate on the level of precaution that should be adopted in climate change regulation.[52] Finally, another important contribution lies in their ability to produce narratives about climate change by creatively interweaving and combining technoscientific, justice and rights-based arguments and framings and effectively

[48] J.Iris Allan et al., n7, 601.
[49] Bruno Latour, *Down to Earth: Politics in the New Climatic Regime* (Polity Press 2018) 82.
[50] Clair Gough & Simon Shackley, 'The respectable politics of climate change: the epistemic communities and NGOs' (2001) 2 *International Affairs* 77, 332.
[51] Ibid, 338.
[52] Ibid, 339.

mobilising them before courts. This has manifested in the form of novel arguments about collective and proportional responsibility and the framing of climate change as an emergency. I accordingly contend that in the post-Paris era, NGO-driven climate litigation represents a continuation and logical apotheosis of earlier global lobbying and advocacy efforts. These co-productive contributions of NGOs to climate litigation and the development of an emergent transnational body of climate change case law are documented in detail below in Parts III and IV.

III. Structurally Convergent or Similar Claims

In this section, I employ Waldron's concept of *ius gentium* outlined in Chapter Five to argue that structurally similar climate change lawsuits around the world and growing cross-citational practices therein are constitutive of an emergent transnational case law on climate change. Litigants' claims are generally built on a similar foundation, comprising the strategic mobilisation and application of universal climate science (e.g. IPCC assessments) and similar or even identical patterns of science-driven legal argumentation. Constitutive features of this new transnational climate change case law include endangerment narratives, administrative claims involving challenges to environmental impact assessments (EIAs), rights-based claims and public trust claims. In this section, I specifically map parallel developments in climate change lawsuits around the world, which exemplify structural likeness or convergence in legal argumentation rather than involving claimants' direct citation of foreign cases.

A. Science-based endangerment narratives

The contemporary realities of climate litigation seriously challenge preconceptions about a rigid dichotomy or opposition between technoscientific framings of climate change on the one hand and human rights and justice framings. Closer examination of climate change lawsuits reveals that all these framings are increasingly synthesised and used by claimants in complementary ways. NGOs and individual claimants have given technoscientific framings of climate change renewed emphasis through the recurrent invocation and use of IPCC assessments and event attribution studies to construct and put forward rights-based endangerment narratives before courts.

Recurrent application of IPCC assessments and carbon budget framework

As discussed in Chapter Five, IPCC assessments, particularly the 2014 Fifth Assessment Report (AR5), constitute the foundational evidentiary glue of several high-profile, public interest climate change lawsuits since 2015 due to their near-universal acceptance as an authoritative synthesis of global climate science. Given both its universality and its exposition of climate change as a global phenomenon, AR5 is proving to be a highly enabling epistemic resource for transnational litigant networks. It allows them to frame climate change as a series of transboundary harms and therefore concurrently litigate the problem across multiple jurisdictions. This prospect is reinforced by states' universal membership of the Paris Agreement. Indeed, the post-Paris era has been marked by a growing wave of climate change lawsuits against both governments and corporations, which seek to hold these actors accountable for climate-related harms projected to result from continuing and unabated GHG emissions.

The year 2015 marked a new phase in transnational climate litigation with the watershed NGO lawsuit *Urgenda v The Netherlands*. The ENGO Urgenda popularised the use of IPCC science in climate litigation and encouraged the strategic merging of scientific and rights-based framings of climate change to mount a robust legal challenge to government inaction. Urgenda asserted that the GHG emissions of the Dutch government are contributing to dangerous climate change and are unlawful since they constitute a violation of the latter's duty of care pursuant to Article 6:162 of the Dutch Civil Code (DCC) and Articles 2 (the right to life) and 8 (the right to respect for private and family life) of the European Convention on Human Rights (ECHR).[53] To establish that the Dutch government owed a duty of care to prevent dangerous climate change and reduce its GHG emissions to 25-40% below 1990 levels by 2020, "so as to prevent the violation of the rights and freedoms of as laid down in Article 2 and 8 ECHR,"[54] Urgenda relied on IPCC assessments to construct a broader narrative of endangerment. Urgenda contended that the danger of climate change is apparent as confirmed by the IPCC and international community's consensual conclusion that a 2°C rise in global temperatures would constitute 'dangerous' anthropogenic interference with the climate system.[55] Joining the international consensus, the Netherlands had also previously acknowledged that exceeding a 2°C threshold would be dangerous.

On the likelihood of that danger manifesting if the 2°C threshold is exceeded, Urgenda submitted that the IPCC and other scientific institutions like the International Energy Agency agree with 95% confidence that the level of the danger would be very great in

53 *Stichting Urgenda v. Government of the Netherlands (Ministry of Infrastructure and the Environment)*, ECLI:NL:RBDHA:2015:7145, Rechtbank Den Haag, C/09/456689/HA ZA 13-1396 - Summons, 103-104, at [363]-[364].
54 Ibid, 74, at [233].
55 Ibid, 104, at [367]; See IPCC, 'Fifth Assessment Report (AR5): The Physical Science Basis' (2013) <https://www.ipcc.ch/report/ar5/wg1/> accessed 15 November 2015.

the absence of more ambitious climate abatement policies.[56] Urgenda further submitted a substantial list of catastrophic climate change impacts documented by the IPCC.[57] Within this submission, it also listed specific climate impacts contributing to a general state of endangerment in Europe and the Netherlands such as "glacial melt, longer growing seasons and a shift in natural habitats, extreme weather events, and increased water stress due to disparities between wet and dry periods."[58]

Based on an aggregation of national and regional scientific data and IPCC findings, Urgenda argued that there is sufficient scientific evidence to conclude that there is a causal relationship between anthropogenic emissions and climate change, including atmospheric and oceanic warming.[59] Secondly, it stated that the consequences of such warming and climate change are *overwhelmingly negative and threatening* as attested by Part I of AR5 on the physical science basis of climate change.[60] Finally, Urgenda concluded its endangerment narrative by suggesting that, based on current global and national policies on climate change, the world is hurtling towards 4°C or more of warming by 2100 (i.e. an unacceptable level of danger or risk).[61] The unabated GHG emissions of the Netherlands (one of the highest per capita) are unlawful and contributing to dangerous climate change.[62] No one country is individually responsible for causing climate change, meaning that the 'but for' test of causation cannot be satisfied.[63] However, Urgenda argued that every country including the Netherlands has

[56] *Urgenda*, n53, Summons, 38.
[57] Ibid, 38-39.
[58] Ibid, 3, 39.
[59] Ibid, 42.
[60] Ibid, 43.
[61] Ibid.
[62] Ibid, 100-102.
[63] RHJ Cox, 'The Liability of European States for Climate Change' (2014) 30 *Utrecht Journal of International* Law 78, 133.

contributed a percentage share to the global stock of GHG emissions and the Netherlands is therefore severally or proportionally liable to adopt preventive measures to avoid dangerous climate change.[64]

Urgenda's strategic fusion of technoscientific and rights-based framings of climate change proved successful in the appeal proceedings. The Hague Court of Appeal (COA) and Dutch Supreme Court both accepted Urgenda's contention based on IPCC climate science that the Dutch government owed a duty of care pursuant to Articles 2 and 8 of the ECHR to "counter the genuine threat of dangerous climate change,"[65] which it had violated by failing to adopt more ambitious mitigation targets and allowing GHG emissions to continue unabated within its territory. With respect to Urgenda's claims pursuant to Articles 2 and 8 ECHR, the COA held that Urgenda was entitled to bring a public interest claim on behalf of Dutch citizens "who fall under the State's jurisdiction [to] invoke Articles 2 and 8 ECHR in court, which have direct effect," and that Urgenda's "ground of appeal in cross-appeal is therefore well-founded,"[66] since Urgenda itself had "sufficient interest in this claim."[67]

The COA ruled that the Dutch state has a positive obligation "to protect the lives of citizens within its jurisdiction under Article 2 ECHR" and under Article 8 ECHR "to protect the right to home and private life,"[68] which applies to all activities that would endanger such rights including industrial activities.[69] Taking judicial notice of IPCC

[64] *Urgenda*, n53, Summons, 44.
[65] *Government of the Netherlands (Ministry of Infrastructure and the Environment) v Stichting Urgenda*, ECLI:NL:GHDHA:2018:2610, The Hague Court of Appeal (COA), at [34]-[38], [45]; *Government of the Netherlands (Ministry of Infrastructure and the Environment) v Stichting Urgenda*, ECLI:NL:HR:2019:2007, Supreme Court of the Netherlands, at [5.6.2].
[66] *Urgenda II*, Ibid, at [36].
[67] Ibid, at [38].
[68] Ibid, at [43].
[69] Ibid.

AR5, particularly on the risks of reaching climate tipping points and the catastrophic impacts of a temperature rise between 1 to 2°C, the COA opined that, "it follows from Articles 2 and 8 ECHR that the state has a duty to protect against this real threat" of dangerous climate change.[70]

Recognising that "climate change affects human rights,"[71] the Dutch Supreme Court affirmed the decision of the COA with respect to Articles 2 and 8 ECHR and further opined that, in giving substance to these articles, "one must take into account *broadly supported scientific insights"* (emphasis added).[72] The court then considered IPCC AR4 and, in line with this assessment, the vast support that exists in the global scientific, policy and legal communities for the necessity of reducing emissions by 25-40% below 1990 levels by 2020.[73] Notably, the court held that the Dutch state's obligation towards its own citizens pursuant to Articles 2 and 8 ECHR to counter the threat of dangerous climate change is preventive in nature and encompasses both mitigation and adaptation measures.[74]

Urgenda's argumentative approach, particularly with respect to challenging suboptimal emissions reduction targets, has been emulated by claimants in many subsequent climate change lawsuits both within and beyond Europe. Notable post-*Urgenda* lawsuits which also use AR5 as an evidentiary foundation include *Saul Luciano Lliuya v RWE*, *In re Greenpeace Southeast Asia & Ors, Juliana et al v USA,* and *Thomson v Minister for Climate Change*. Directly taking a leaf out of Urgenda's playbook, the claimant in the

[70] *Urgenda II*, n65, at [44]-[45].
[71] *Urgenda III*, n65, at [5.7.9].
[72] Ibid, 5, at [6.1]-[7.3.6].
[73] Ibid, 5.
[74] Ibid, at [5.3.2].

2015 New Zealand case of *Thomson* argued that the Climate Change Response Act compels the Minister for Climate Change to prescribe a more ambitious GHG emissions reduction target for 2050 directly in line with AR5 and periodically review and revise this target following the release of every new IPCC assessment.[75]

The claimant's endangerment narrative is also nearly identical to Urgenda's and relies on the same key findings from AR5 on the anthropogenic basis and impacts of atmospheric and oceanic warming, ice-melt and sea level rise.[76] Like Urgenda, the claimant also emphasised New Zealand's high per capita contribution to climate change as a developed country emitter and its responsibility to reduce GHG emissions drastically by setting a more ambitious 2050 mitigation target in accordance with AR5 and its INDCs under the Paris Agreement.[77] In Canada, the ENGO ENVironnement JEUnesse has adopted the same approach to challenge the Canadian government's 2050 mitigation targets in the Quebec Superior Court. The claimant has used the same findings from AR5 to frame Canadian endangerment as a public health emergency due to increased extreme heatwaves in recent years which have precipitated a spike in hospitalisations.[78]

In *Plan B Earth v Secretary of State for Transport*, the NGO claimant did not directly invoke AR5, but argued in nearly identical terms to the claimants in *Urgenda*, *Thomson* and *ENVironnement JEUnesse* that under UK Climate Change Act, the Transport

[75] *Sarah Thomson v Minister for Climate* Change 'Statement of Claim' (2015) <http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2015/20151110_2017-NZHC-733_complaint-1.pdf> 7, paras [72]-[77], accessed 22 May 2018.
[76] Ibid, at [15]-[54].
[77] *Thomson*, n64, at [71]-[87].
[78] *ENVironnement JEUnesse v Attorney General of Canada*, 'Statement of Claim' (2018) < http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2018/20181126_500-06_application-2.pdf > at [2.18]-[2.22], accessed 24 May 2018.

Secretary was obliged to review and revise the UK's 2050 mitigation target in line with "significant developments in scientific knowledge about climate change."[79] This can arguably be read as an implicit reference to AR5 and national equivalents.

In *Lliuya v RWE*, another the NGO lawsuit, the claimant's case also relies substantially on AR5 and climate science studies that have concretely documented specific climate change impacts such as glacial melt in the Peruvian Andes.[80] The IPCC has exhibited "a very high degree of confidence" in climate change-induced glacial retreat in the Andes.[81] Relying on AR5, the claimant alleges that RWE's emitting activities have caused major climate change impacts such as glacial melt likely to result in the flooding of the Palcacocha glacial lake, which have placed Lliuya's home and village at high risk from floodwaves.[82] Finally, in a series of climate change lawsuits filed by municipal governments in California against fossil fuel corporations, claimants have crafted endangerment narratives based on a combination of IPCC, national and subnational scientific assessments. In similar terms to the claimants in the cases discussed above, the claimants in the *City of Oakland v BP p.l.c* reiterated AR5's findings on anthropogenic warming and highlighted that the 'melting of the West Antarctic ice sheet, "the most vulnerable to global warming," will cause especially severe impacts in California.'[83]

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[79] *Plan B Earth and Others v Secretary of State for Transport,* 'Statement of Claim' (2018) < http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2018/20180806_2019-EWHC-1070-Admin_complaint.pdf> 6, at [11], accessed 22 May 2018.

[80] IPCC AR5, n53.

[81] Ibid.

[82] *Saul Luciano Lliuya v RWE* (2017) 20171130 Case No-2-O-28515.

[83] *City of Oakland v BP p.l.c,* 'Statement of claim,' (2017) < http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2017/20170919_docket-CGC-17-561370_complaint.pdf> at [48]-[51], accessed 23 May 2019.

As previously discussed in Chapter Five, in a cluster of recent cases, litigants have also applied the IPCC 's carbon budget framework. In *Carvalho v EU*[84] (The People's Climate Case), the claimants (ten families and the Swedish Saami Youth Association) have also heavily relied on AR5 to frame their arguments. The case is a pertinent illustration of climate litigants' creative synthesis of AR5, the SR15 carbon budget approach and the Paris Agreement. This has led to the case being described as "a laboratory for examining the interface of climate science, law and economics."[85] The claimants have argued that the EU regime on mitigation – comprising ETS Directive 2018/410, the Climate Action Regulation and the LULUCF Regulation ('the GHG Emissions Acts'), which set an overall reduction target of 40% below 1990 levels by 2030 – leaves a remaining and permissible emissions budget of 60% of emissions at 1990 levels to 2030 (or 3392 Mt CO_2 eq), which is still far too high and is likely to adversely impact their livelihoods.[86]

The claimants argue that this remaining budget exceeds what is required under higher-ranking law, namely human rights law (The EU Charter Fundamental Rights) and international law (The Paris Agreement).[87] They have accordingly sought to have the existing mitigation provisions of the GHG Emissions Acts nullified or, alternatively, an injunction to compel the EU to revise its mitigation provisions in line with higher-ranking law and thereby adopt more ambitious mitigation targets.[88] The claimants rely more generally on AR5 to sketch an extensive list of impacts likely to be experienced

[84] *Carvalho*, n26.
[85] Gerd Winter, 'Armando Carvalho and Others v EU: Invoking Human Rights and the Paris Agreement for Better Climate Protection Legislation' (2020) 9 *Transnational Environmental Law* 1, 137.
[86] *Carvalho*, n26, at [2]-[3].
[87] Ibid, at [3].
[88] Ibid, at [3], [8].

as a result of climate change and global temperature rise, including *inter alia* disrupted livelihoods from sea-level rise, coastal flooding, extreme weather events, extreme heat, food insecurity, and the loss of marine and coastal ecosystems and biodiversity.[89] They have also relied on AR5 to document a list of specific climate change impacts likely to be experienced by them including, for example, the loss of agricultural livelihoods for the Carvalho family due to deforestation and adverse impacts on reindeer herding and food security for the Saami claimants.[90] Notably, the claimants have derived their calculation of the remaining GHG emissions budget for the EU through their application of the carbon budget approach prescribed in SR15 and outlined in Chapter Five.[91] The claimants note that the IPCC's carbon budget is overly generous and allows for excessive emissions[92] and argue for a higher level of ambition for EU climate change mitigation.

Applying SR15's carbon budget framework, the claimants have calculated the EU's emissions budgets per capita, as a share of the overall global carbon budget. [93] Using a lower-end temporal baseline of 2021, the claimants have estimated that the EU's remaining emissions budget is 7.46 years, which they predict will be consumed before 2030.[94] The claimants have provided a range for when available EU emissions budgets may be exhausted:

> The 2°C budget is exhausted in 2027 (or 2034 or 2041, respectively) if emissions remain constant after 2020, and exhausted in 2034 (or 2048 or 2061, respectively) where linear emissions reductions are made. The 1.5°C budget is exhausted

[89] *Carvalho*, n26, at [14]-[42].
[90] Ibid, at [46]-[49]; [83]-[86].
[91] Ibid, at [259]-[263], [275]-[284].
[92] Ibid, at [263].
[93] Ibid, at [259]-[271].
[94] Ibid, at [281].

> in 2024 (or 2023 or 2024, respectively) if emissions remain constant after 2020, and exhausted in 2027 (or 2026 or 2028, respectively), where linear emissions reductions are made.[95]

By using the IPCC's carbon budget framework to generate these projections of the EU's remaining carbon budgets, the claimants have sounded the alarm and raised global awareness about the inadequacy of the EU's mitigation targets and the fact that rapid and deep cuts to EU GHG emissions (an 80% reduction as per a 2°C warming scenario[96]) are urgently required. In addition, they have applied the prevention principle to require that the EU spend its remaining carbon budget in a linearly regressive manner.[97]

The claimants in the US case, *WildEarth Guardians v Bernhardt et al*[98], have also applied the IPCC carbon budget framework, which is an important pillar of the evidentiary basis for their claims. The litigants, which comprise several citizen groups, have brought action against a US government agency, the Bureau of Land Management (BLM), to challenge its approval of 2067 oil and gas leases across the United States.[99] The claimants allege that by failing to consider the "direct, indirect, and cumulative impacts of oil and gas leasing on our climate," and failing to prepare an environmental impact statement before approving 23 leasing authorisation, BLM is in breach of the National Environmental Policy Act (NEPA).[100] The claimants observe that US federal fossil fuel resources contain enough recoverable coal, oil and gas, that if exploited and burned, would result in 492 $GtCO_2$, thereby surpassing the entire global carbon budget

[95] *Carvalho*, n26, at [281]- [282].
[96] Ibid, at [286].
[97] G.Winter, n85, 163.
[98] *WildEarth Guardians and Physicians for Social Responsibility v Bernhardt et al*, No.s 19-cv-001920-RBJ (D.Colo. 11/08/2019).
[99] Ibid, at [1].
[100] Ibid, at [1], [7], [150].

for 1.5°C and nearly eclipsing the 2°C target.[101] Federal fossil fuels comprise 91% of these potential emissions, with already leased federal fossil fuels accounting for approximately 43 $GtCO_2$, which has expended almost all of the US' remaining carbon budget.[102]

Based on these carbon budget calculations, the claimants argue that *any* new leasing of federal fossil fuel resources is inconsistent with a carbon budget that seeks to avoid catastrophic climate change.[103] The claimants also argue that if BLM ceased its leasing and renewal of existing leases of US oil and gas resources, the US could reduce annual CO_2 emissions by approximately 100 Mt by 2030.[104] The claimants are accordingly seeking declaratory and injunctive relief against BLM to prevent new leasing, exploitation and combustion of US fossil fuel resources.[105]

The US claimants' utilisation of the IPCC carbon budget approach in a manner analogous to the European claimants in *Carvalho* again illustrates that US climate litigation is consonant with and not disconnected from transnational climate litigation trends, as argued in Chapter Four. Both cases are also a fitting example of the kind of *science-law co-production* that climate litigants now typically engage in. In particular, they highlight the way in which the IPCC's carbon budget framework and the Paris Agreement's temperature goals have become twin touchstones of post-2015 climate litigation.

101 G.Winter, n85, at [87].
102 Ibid.
103 Ibid.
104 Ibid, at [89]-[90].
105 Ibid, at [11], 50-51.

There are also a handful of climate change lawsuits which do not directly rely on IPCC assessments such as AR5, but are nonetheless noteworthy for their replication of Urgenda's advocacy strategy and argumentative approach in relation to the use of climate science. In these cases, claimants typically employ national analogues or substitutes for IPCC assessments. For example, in the United States – a jurisdiction in which there is greater resistance to the use of foreign materials in some courts[106] – claimants have relied on national and subnational climate science assessments. Shortly after *Urgenda*, in September 2016 the ENGO Conservation Law Foundation (CLF) filed a federal civil suit in the US against ExxonMobil for water pollution and climate change damage in New England.

At first glance, the US may appear *sui generis* and insular as a jurisdiction. However, on closer inspection, the degree of separation between the US and other jurisdictions in relation to climate litigation is skin-deep, since like the claimants in the cases discussed above, CLF also relied extensively on climate science, namely the Third National Assessment (TNA) and the Massachusetts Climate Adaptation Report (MCAR) which adopts the IPCC's findings. CLF mobilised this IPCC-inflected technoscientific framing of climate change to argue that ExxonMobil's operations in New England have substantially contributed to climate change-induced sea level rise thereby endangering the health and wellbeing of New England residents.[107] CLF relied on the MCAR to argue that Massachusetts residents are at significant risk from climate impacts that are projected to result from ExxonMobil's unabated GHG emissions. These include further sea level rise, coastal flooding, extreme precipitation events which will increase the

[106] J.Waldron, n8.
[107] *Conservation Law Foundation v ExxonMobil Corp* (2016) 1:16-cv-11950 (Complaint) <http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2016/20160929_docket-116-cv-11950_complaint-1.pdf> accessed 27 February 2019, 21-22.

height of storm surges, shoreline erosion, destruction of vital coastal infrastructure including flood defences and ultimately the loss of vast tracts of habitable coastal land.[108]

These cases exemplify how the universally authoritative status of climate science is encouraging and enabling litigants to put forward almost identical or analogous endangerment narratives in courts around the world. Notwithstanding the contingent national circumstances and differences in legal systems, cultures and areas of law, IPCC assessments such as AR5 and increasingly SR15's carbon budget framework, are transnational common denominators which have emboldened litigants to lobby for convergent interpretations of states' legal obligations on climate change mitigation (e.g. in accordance with the requirement of higher ambition under the Paris Agreement), adaptation and human rights protection in the face of adverse climate impacts.

The growth of event attribution science

Science-law co-production is also visible in relation to attribution science on extreme weather events, which is increasingly being used by climate litigants to frame and advance endangerment narratives before courts with the aim of satisfying causation requirements. There have been many recent signs indicating that the causation limbo in climate change cases is gradually being dismantled and causal evidentiary difficulties will no longer be insurmountable obstacles for claimants. IPCC AR5, the IPCC scientific consensus, and the growing body of climate change research on attribution in recent years have arguably shifted the dynamics of proof towards the possibility of successfully attributing liability for specific climate change impacts and quantifying the

[108] *Conservation Law Foundation*, n107, 23-29.

historical contributions of major carbon producers. Richard Heede's Carbon Majors Study is the best-known example of this new wave of climate change research and is notable for its quantification of the cumulative emissions of 90 of the world's largest carbon producers from 1854-2010.[109] The study calculates and ascribes a percentage figure to each individual emitter or 'Carbon Major Entity' (CME) to mark their proportionate contribution to global anthropogenic GHG emissions.[110] It ultimately concludes that the aggregate emissions of CMEs constitute approximately two-thirds (63%) of all global anthropogenic GHG emissions. Crucially, the study also concludes that the 90 CMEs released more than half of their total contribution of emissions after 1988, which suggests that the roots of the problem are easier to trace and more recent.[111]

Many commentators have hailed the Carbon Majors study as "a turning point in the debate about apportioning responsibility for climate change" and have praised it as the "first study of its kind to [identify] a discrete class of defendants" in climate change litigation.[112] The Environmental Law Alliance Worldwide (ELAW) observes that such research "removes the previously insurmountable hurdle for grassroots lawyers seeking to hold major emitters accountable" and will better enable them to meet the burden of causation in legal proceedings.[113] Outside the US, there is already an emerging trend in private climate litigation that evidences an increased reliance by plaintiffs upon such attribution studies. As discussed in Chapter Five, in *Lliuya v RWE*, a Peruvian farmer

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109 Richard Heede, 'Tracing Anthropogenic Carbon Dioxide and Methane Emissions to Fossil Fuel and Cement Producers, 1854–2010' (2014) 122 *Climatic Change* 1, 229–241.
110 Ibid.
111 Ibid.
112 Douglas Starr, 'Just 90 companies are to blame for most climate change, this carbon accountant says' *Science Mag* (August 2016) <http://www.sciencemag.org/news/2016/08/just-90-companies-are-blame-most-climate-change-carbon-accountant-says> accessed 23 March 2017.
113 Environmental Law Alliance Worldwide, 'Holding Corporations Accountable for Damaging the Climate' (2014) <https://www.elaw.org/system/files/elaw.climate.litigation.report.pdf> accessed 23 March 2017.

filed a damages claim in Germany against RWE in 2015 which was based on a finding in the Carbon Majors Study that 0.47% of carbon emissions emitted during the industrial era could be traced back to RWE.[114] Similarly, in September 2015, the Philippines Reconstruction Movement and Greenpeace Southeast Asia filed a petition at the Philippines' Commission on Human Rights on behalf of 13 organisations and 20 individuals requesting that the Commission exercise its investigative powers to examine the role of Carbon Majors in causing climate change and ocean acidification.[115] A lawyer for Greenpeace's Global Climate Justice and Liability Project in Toronto Canada, Kristin Casper, confirmed that the Carbon Majors study was "one of the bedrock pieces of science research that helped form our campaign."[116]

It is also becoming increasingly possible to identify specific categories of climate harms that are typically being experienced by particular groups and local communities. Existing climate science documents sub-regional impacts, such as coastal erosion and sea-level rise in many parts of the US, particularly South-Eastern states like Louisiana.[117] The IPCC has also stated with high confidence that polar regions will be some of the worst affected, since rising temperatures are causing rapid sea-ice and permafrost melt.[118] The Arctic is changing at an alarming rate, with recent scientific data indicating record low levels of ice cover and unusually high temperatures.[119] NASA

[114] *Lliuya v RWE*, n13.
[115] *In re Greenpeace Southeast Asia et al. (Commission on Human Rights of the Philippines, 2015)* < http://www.lse.ac.uk/GranthamInstitute/litigation/in-re-greenpeace-southeast-asia-et-al-2015-__-commission-on-human-rights-of-the-philippines-2015/> accessed 15 March 2019.
[116] D.Starr, n112.
[117] IPCC AR5, n53; David A. Grossman, 'Warming Up To A Not So Radical Idea: Tort-based Climate Change Litigation' (2003) 28 *Columbia Journal of Environmental Law* 1, 12-13
[118] IPCC AR5, Ibid.
[119] IPCC AR5, n53; NASA, 'NASA Studies Details of a Greening Arctic' (June 2016) < https://www.nasa.gov/feature/goddard/2016/nasa-studies-details-of-a-greening-arctic> accessed 28 March 2017.

climate scientists have labelled this trend "Arctic greening."[120] Both organisations have also identified Alaska as being susceptible to this trend and as a high-risk state that is already being profoundly affected by climate change. The American legal context attests to the credibility of these scientific findings, as coastal communities from Louisiana and Alaskan Inuit peoples have already appeared as plaintiffs in high profile climate change lawsuits and are likely to be repeat players in future litigation as climate change impacts intensify.

The Carbon Majors Study is only a starting point in climate attribution research. Climate scientists are already beginning to observe and declare the existence of "human fingerprints" on single extreme climatic events such as droughts, heatwaves, and floods based on a series of new studies on planetary waves. Renowned climate scientist and author of a leading study on planetary waves, Michael Mann, observes that "human activity has been suspected of contributing to this pattern of activity before, but now we uncover a clear human fingerprint of human activity."[121] NASA attribution studies are also in a growth phase and have so far calculated the likelihood of the occurrence of extreme climatic events as a result of warming. For example, such studies have shown that a heatwave in South Australia in 2009 was made twice as likely and floods in the Northern UK in 2015 were made 40% more likely due to anthropogenic climate change.[122] It is highly likely that future IPCC assessment cycles will be devoted to the aggregation, vetting, and synthesis of event attribution science and unearth more

[120] NASA, Ibid; See Junchang Ju & Jeffrey G. Masek, 'The vegetation greenness trend in Canada and US Alaska from 1984-2012 Landsat data' (2016) 176 *Remote Sensing of Environment* 1.
[121] Damian Carrington, 'Climate change: 'human fingerprint' found on extreme weather events' *The Guardian* (27 March 2017) < https://www.theguardian.com/environment/2017/mar/27/climate-change-human-fingerprint-found-on-global-extreme-weather> accessed 28 March 2017; See Michael E. Mann, Stefan Rahmstorf, Kai Kornhuber, Byron A. Steinman, Sonya K. Miller & Dim Coumou, 'Influence of Anthropogenic Climate Change on Planetary Wave Resonance and Extreme Weather Events' (2017) *Scientific Reports* 7.
[122] D.Carrington, n121; NASA, n87.

detailed data about specific climate change impacts and single extreme climatic events, all of which will better enable plaintiffs to satisfy causation requirements and assist courts in holding major emitters accountable.

Event attribution science or Probabilistic Event Attribution (PEA) is an emerging branch of climate science concerned with assessing and quantifying the extent to which extreme weather events can be linked to past anthropogenic GHG emissions, also known as 'attributable risk.'[123] It has been recognised as a vital repository of evidence and information for legal regimes surrounding loss and damage and civil liability (i.e. climate tort) litigation.[124]

Mobilising attribution science: The Market Share Theory

Further preliminary evidence of the development of shared litigation strategies by NGOs in response to the growing body of scientific evidence on climate change can be found in their application of the 'market share theory'[125] to overcome the collective nature of causal data in climate science. In most recent litigation against large fossil fuel companies, the absence of tailored scientific analyses attributing damages to specific parties have led plaintiffs to typically apply the market share theory based on Heede's Carbon Majors study. This posits that the costs a company is liable to pay roughly corresponds to their proportionate contribution to cumulative global carbon-dioxide emissions multiplied by the additional damages incurred from climate change

[123] Friedereke Otto, Rachel James & Myles Allen, 'The science of attributing extreme weather events and its potential contribution to assessing loss and damage associated with climate change impacts' (2018) <https://unfccc.int/files/adaptation/workstreams/loss_and_damage/application/pdf/attributingextremeevents.pdf> accessed 8 April 2019.

[124] Luke J. Harrington & Friedereke Otto, 'Attributable damage liability in a non-linear climate' (2019) 153 *Climatic Change* 15; Sophie Marjanac & Lindene Patton, "Extreme weather event attribution science and climate change litigation: an essential step in the causal chain?" (2018) 36 *Journal of Energy and Natural Resources Law* 3, 22.

[125] S.Marjanac & L.Patton, Ibid, 22; R.Heede, n109.

impacts.[126] As discussed above, claimants in both *Urgenda* and *Lliuya* deployed arguments about the Netherlands' and RWE's proportionate contribution to and responsibility for climate change. Harrington and Otto observe, "this theory relies on several testable assumptions, one of which is the inference that attributable climate change impacts increase linearly with cumulative carbon emissions."[127] They also note that in the lawsuits filed against Carbon Major corporations, calculations of an attributable damage estimate for a fossil fuel company would involve their fractional contribution towards cumulative global emissions multiplied by the corresponding increase in attributable damages over that same time step, with "the sum of all time steps then [yielding an] attributable damage estimate for that company."[128] While current attribution science has successfully elucidated the historical emission profiles of Carbon Major companies, it is not yet known what trajectories (including non-linear ones) emergent climate impacts will follow alongside rising cumulative emissions. Harrington and Otto observe that the latter will be crucial for assigning responsibility and meeting the challenges of climate change adaptation.[129] They also summarise PEA's immediate research priorities which are pertinent to climate litigation in the following terms:

> Specific research priorities include understanding to what extent different types of climate change impacts can deviate from the assumption of a linear response to warming, as well as whether the qualitative shape of impact profiles is sensitive to the baseline period from when we consider changes.[130]

[126] S.Marjanac & L.Patton, n124, 22.
[127] L.J.Harrington & F.Otto, n124, 16.
[128] Ibid, 18.
[129] Ibid.
[130] Ibid.

Mobilising attribution science: Framing climate change as an 'emergency'

An emergent strand of the endangerment narrative is the framing of climate change as an 'emergency' by litigants based on their strategic reliance upon event attribution science. *In re Greenpeace Southeast Asia & Ors* provides the clearest illustration of this strategy, with the NGO petitioners mobilising support for their specific framing of climate change as a 'human rights emergency' from the some of the world's leading climate scientists at the Philippines Human Rights Commission's New York and London hearings in September and November 2018, respectively. Notably, all three climate scientists who provided amicus-style testimony during these hearings – James Hansen (New York), Brenda Ekwurzel (New York) and Myles Allen (London) – have served as lead authors of IPCC reports and possess substantial expertise on attribution.

Although PEA is still in its infancy, certain statements submitted by these three eminent climate scientists in support of the petitioners' claims at the Philippines Human Rights Commission's hearings appear to add weight to and provide some clarification on the above theories and calculations on climate change attribution. Moreover, these scientists used their testimonies to raise awareness about the ramifications of extreme weather events like hurricanes for social justice and the human rights of Filipino citizens. In doing so, they explicitly tethered a scientific framing of climate change to a justice and rights-based narrative of wider societal endangerment. James Hansen spoke at length about ocean surface temperature rise, ice melt, sea-level rise and amplifying feedbacks as well as extreme weather events like hurricanes (also known as cyclones or typhoons). In relation to the latter, he identified significant increases in wind intensity and higher

storm surges as consistent with anthropogenic forcing.[131] He specifically noted that rising ocean temperatures provide greater fuel for increased cyclonic activity, including tropical thunderstorms and typhoons and that "super typhoon Haiyan had the strongest sustained winds over land ever recorded, reaching 195 mph, well over 300 km per hour."[132]

Brenda Ekwurzel, the Director of Climate Science at the Union of Concerned Scientists, opined that certain climate change impacts and extreme weather events have more clearly identifiable human fingerprints. Noting that "attribution science has advanced to now assess the contribution of human-induced climate change to many types of extreme events," she stressed that the strongest attribution evidence exists in relation to hurricanes, extreme rainfall from hurricanes, extreme precipitation and high tide flooding from storm surges.[133] Ekwurzel identified hurricanes Sandy in New York (2012) and Harvey in the US Gulf Coast (2017) as incidents with respect to which attribution evidence is robust. Attribution studies have revealed that predominantly anthropogenically-induced sea-level rise of 20cm during the 20th century led hurricane Sandy to cause flooding in an area approximately 70km2 greater than it would have in

131 James Hansen (4th Inquiry hearing in New York for *Greenpeace Southeast Asia et al v Carbon Majors*), 'Ongoing Global Climate Change and Consequences,' (2018) <https://www.dropbox.com/sh/38pc0ojxoxat0mx/AABYjL-9akEWUEuauJcB9Ndia/CHR%20Resource%20Persons%20PowerPoint%20Presentations?dl=0&subfolder_nav_tracking=1> accessed 8 April 2018.

132 Ibid.

133 Brenda Ekwurzel, 'Statement for the Commission on Human Rights Inquiry Hearing' (2018) <https://www.dropbox.com/sh/38pc0ojxoxat0mx/AAAucu6TnYagXvdKlMIzMFlga/Brenda%20Ekwurzel?dl=0&preview=Exh+EEEEEEE+Brenda+Ekwurzel+Statement.pdf&subfolder_nav_tracking=1> accessed 8 April; Brenda Ekwurzel, 'Presentation for the Republic of the Philippines Commission on Human Rights National Enquiry on Climate Change fourth round of public hearings, New York, USA, September 27 2018' (2018) <https://www.dropbox.com/sh/38pc0ojxoxat0mx/AAAucu6TnYagXvdKlMIzMFlga/Brenda%20Ekwurzel?dl=0&preview=Exh+GGGGGGG+Brenda+Ekwurzel+PowerPoint.pptx&subfolder_nav_tracking=1#> accessed 8 April 2019.

1880.[134] With respect to hurricane Harvey, another study has shown that anthropogenic climate change "made precipitation about 15% more intense, or equivalently made such an event 1.5-5 times more likely."[135] Situating super typhoon Haiyan on a continuum with these events, Ekwurzel cited another important attribution study comparing Haiyan to a late 19th century typhoon in the Philippines which concluded that the former was "more intense, had larger maximum wind coverage, and moved faster" and the associated "storm surge was about twice the height of the 1897 event in San Pedro Bay."[136]

Finally, at the 5th hearing in London, Myles Allen, a professor of Geosystem Science at Oxford who has contributed extensively to the development of attribution science as a field, discussed his contribution as lead author to the IPCC Special Report (2018) and focused on an attribution study by Izuro Takabuyo on super typhoon Haiyan which "demonstrates how the size and impact of a storm surge from a typhoon might have been exacerbated by anthropogenic climate change."[137] With respect to the IPCC Special Report (and on the topic of general attribution of climate change to anthropogenic GHG emissions), Allen noted that a key finding was that "human-induced global warming has now reached 1°C relative to the period 1850-1900, which may be considered approximately representative of pre-industrial

[134] B.Ekwurzel, n133; K.G.Miller et al, 'A geological perspective on sea-level rise and its impacts along the US mid-Atlantic coast' (2013) 1 *Earth's Future* 1, 3–18.
[135] B.Ekwurzel, Ibid; G.J. van Oldenborgh et al , 'Warm US Februaries becoming much more common' (February 2017) <www.worldweatherattribution.org/analyses/u-s-heat-february-2017> accessed 1 June 2018.
[136] B.Ekwurzel, Ibid; J. L. A Soria et al, 'Repeat storm surge disasters of Typhoon Haiyan and its 1897 predecessor in the Philippines' (2015) *Bulletin of American Meteorological Society*.
[137] Myles Allen, 'National inquiry on the impact of climate change on the human rights of the Filipino people: Statement of Resource Person Myles Allen,' (2018) < https://www.dropbox.com/sh/gx8x4wu9npetpeq/AADm3Enz8mxpmmDmyeHma3ATa/Myles%20Allen?dl=0&preview=Exh+PPPPPPPP+ALLEN+Statement.pdf&subfolder_nav_tracking=1> accessed 9 April 2018, 3.

conditions…[meaning] that all observed warming since 1850 can be considered anthropogenic, with 80% of that warming due to carbon-dioxide emissions."[138] With respect to event attribution (and in alignment with Ekwurzel's observations), Allen remarked that "based on evidence available from current climate models…the probabilities of many potentially damaging extreme weather events including heatwaves and short-duration extreme precipitation events, increase predictably with rising global temperatures."[139] He subsequently relied upon Takabuyo's attribution study to show that super typhoon Haiyan was indeed intensified by anthropogenic warming. Key characteristics of such a warming-intensified hurricane include higher storm surges which are a primary consequence of higher wind speeds.[140]

Notably, all three climate scientists assumed a more hybrid role of the activist-scientist or scientist-advocate as they emphasised the imperative of urgently addressing the dire human rights and social justice implications of these extreme events resulting from unabated anthropogenic climate change. Hansen specifically identified three tiers of climate injustice, namely intergenerational inequity or injustice inflicted upon young people, injustices perpetrated by the global North towards the global South and injustice inflicted by humans upon other species.[141] Allen considered adverse implications for human health and economic growth in the Philippines[142] and Ekwurzel commented on the moral culpability of the oil industry for misleading the public despite having prior

[138] M.Allen, n137, 3; IPCC, 'Global Warming of 1.5C: Summary for Policy Makers' (SR15) (2018) < https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf> accessed 27 June 2019.
[139] M.Allen, Ibid, 3; Izuro Takabuyo et al, 'Corrigendum: Climate change effects on the worst-case storm surge: a case study of Typhoon Haiyan' (2015) 10 *Environ. Res. Lett.* 8.
[140] I.Takabuyo et al, Ibid.
[141] J.Hansen, n131.
[142] M.Allen, n137.

knowledge about climate change from internal scientific research conducted in the 1970s and 1980s.[143]

By merging attribution science with justice and rights-based discourses in this manner, all three scientific (or rather trans-scientific) testimonies were largely complementary and harmonious with one another. They were also pivotal to the petitioners' case since they were used to complement and corroborate the personal testimonies provided during the hearings by several Filipino citizens in relation to their experiences surrounding super typhoon Haiyan. For example, one of the typhoon survivors and community witnesses Marielle Bacason, a London-based Filipino nurse, recollected her experience of the typhoon and its ramifying social impacts. These comprised forced migration (a recognisable adaptation response to such extreme climatic events), being pushed into survival mode, experiencing severe trauma as a result of losing her home and family members and living in perpetual fear of being attacked and sexually assaulted.[144] In a telling statement that sheds light on the extent to which climate change may have affected the typhoon's intensity, Bacason noted that "growing up I thought the strongest typhoon was signal number 3. In my lifetime, I was able to experience signal number 5."[145] Furthermore, in their closing statement for the hearings, the NGO coalition representing the petitioners was unequivocal about the power of event attribution science as an explanatory, enabling and legitimating force for their social justice and rights-based claims:

[143] B.Ekwurzel, n133.
[144] Marielle Trixie J.Bacason, 'Statement at 5th Inquiry Hearing in London' (2018) < https://www.dropbox.com/sh/gx8x4wu9npetpeq/AAA7HM64jGQtWnfOj5VK6PGWa/Community%20Witnesses%20Statements?dl=0&preview=Exh+NNNNNNN+Statement+of+Marielle+Bacason.pdf&subfolder_nav_tracking=1> accessed 15 April 2019, 3.
[145] Ibid, 6.

> With event attribution science, we can now detect the human fingerprint of climate change on these events. It is becoming clearer that what we once called "natural" disasters are anything but natural. Why is this important to us? Well better science means more communities and individuals like those we have heard can better understand and prove the human rights harms they experienced and are experiencing in their day-to-day lives are connected to climate impacts.[146]

These hearings and trans-scientific testimonies also have wider resonance for transnational climate litigation writ large. Not only do they reflect an emerging global scientific consensus on event attribution with respect to extreme weather events like hurricanes and typhoons. They also foreground the pivotal importance of attribution science for legal inquiries on loss, damage and climate responsibility that are typically enlivened and pursued by affected parties or victims (most often through NGOs) in direct response to such extreme events. Thus, attribution science is concurrently developing alongside and has become inextricably intertwined with social justice and rights-based NGO advocacy and litigation and forms the epistemic crux of the endangerment narratives put forward by climate change victims.

Contrary to scholarly and popular assumptions that COP-21 ushered in a definitive move away from scientific framings of climate change towards justice and rights-based framings, these climate change cases reveal that scientific framings of climate change are alive and well and routinely being used to reinforce the former. Whether they are IPCC assessments, national scientific assessments or attribution studies, scientific framings of climate change have taken on increased significance and relevance in

146 *In re Greenpeace et al*, 'Closing Statement for the Petitioners' (2018) <http://www.greenpeace.org/seasia/ph/PageFiles/735291/Closing%20Statement%20(CHR)_footnotes.pdf> accessed 16 April 2019.

climate litigation and very much remain in wide circulation and usage. Far from obsolete, they continue to serve as the conceptual and discursive foundation of litigants' case theories and claims before courts around the world and foster the development of a cohesive new body of transnational legal practice on climate change.

B. Administrative lawsuits and the standardisation of climate impact assessments

Administrative lawsuits are understood here as public interest lawsuits filed by citizens or NGOs against governments for conduct that may be in violation of legislative requirements such as those pertaining to an Environmental Impact Assessment (EIA).[147] Administrative lawsuits in the post-Paris era aptly showcase the range of creative argumentation and case theories employed by NGOs and civil society organisations through their amalgamation of climate science and environmental law. As discussed in Chapter Four, *Massachusetts v EPA* constitutes one of the earliest examples of administrative climate litigation which resulted in 'expertise forcing,' obliging government agencies like the EPA to consider up-to-date scientific evidence in decision-making in relation to GHG emissions and climate change. Following *Massachusetts*, administrative climate change lawsuits have proliferated both within and outside the United States, with notable examples in other common law countries like the UK, Australia and South Africa. A key factor might be that most major climate science studies and leading climate scientists steering the work of the IPCC are from the US, UK and Australia, which are the major metropolitan sites of knowledge production on climate change.

[147] See Brian J. Preston, 'Climate Change Litigation (Part 2)' (2011) 2 *Climate Change Law Review* 244, 247, 250-251.

These administrative lawsuits exemplify a high level of structural convergence and overlap across common law jurisdictions in terms of both legal practice and adjudication on climate change. These lawsuits have involved challenges to fossil fuel-related development projects (e.g. new coalmines, power plants etc.) or national climate change policies and mitigation targets. This is most apparent in the UK, Australia and South Africa which also possess similar mechanisms for administrative or judicial review under their administrative law regimes.[148] In these countries, NGOs and civil society organisations have filed several claims against central or state governments, seeking administrative or judicial review for administrative errors or unlawful conduct in relation to climate change. Such claims typically allege: i) misapplication of the law (error of law); ii) unreasonable conduct such as the failure to consider relevant factors in a decision-making process (error of fact) and; iii) procedural impropriety including non-compliance with a statutory procedure such as an EIA.[149]

With respect to the third category of legal claims – deficient EIAs – litigants have repeatedly emphasised the pivotal importance of IPCC assessments and climate science, particularly since 2015. Civil society and ENGO claimants have argued that governmental consent for proposed fossil fuel development projects ought to be refused because GHG emissions from these projects would negatively impact upon measures to limit dangerous anthropogenic climate change.[150] In the Australian case, *Gloucester*

[148] Australia also possesses a unique system of administrative review known as ***merits review*****.** Under Australian federal law, as well as New South Wales state law, merits review is the process by which 'a person or body other than the original decision-maker reconsiders the facts, law and policy aspects of the original decision and determines what is the correct and preferable decision.' This is often described as 'stepping into the shoes' of the original decision-maker. Merits review can be undertaken by a tribunal or judge. Australian Review Council: Australian Government, 'What is merits review?' (2020) <https://www.meritprotectioncommission.gov.au/information-about-administrative-review/what-merits-review> accessed 10 February 2020. See also Peter Cane, 'Merits Review and Judicial Review – The AAT as Trojan Horse' (2000) 28 *Federal Law Review* 213.
[149] B.J. Preston, n147, 246.
[150] *Gloucester Resources Ltd v Minister for Planning* (2019) 234 LGERA 257, at [422].

Resources Ltd v Minister for Planning, the civil society group Gloucester Groundswell and the NSW Environmental Defender's Office (EDO) argued that the Rocky Hill development application had to consider the significant and deleterious impacts of a new coalmine on climate change (including indirect or 'Scope 3' emissions) and the town of Gloucester.[151] Although the outcome of the case did not exclusively hinge on determinations about climate change impacts, which were considered alongside the social, amenity, economic, and public impacts of the mine, *Gloucester Resources* nonetheless stands out for its extensive use and consideration of climate science. The claimants' case relied extensively on climate science and was built on a combined foundation of IPCC assessments, national and local risk assessments and impact studies by the Australian Bureau of Meteorology and the CSIRO, and expert testimony from Earth Scientist Will Steffen. Similarly, in the South African *Thabametsi Case*, the ENGO claimant EarthLife Africa argued that Ministerial authorisation for a new coal-fired power plant ought to be set aside on the grounds that they failed to conduct a proper 'climate change screening' as part of the EIA for the project.[152] Such a screening ought to have involved consideration of potential GHG emissions from the proposed project and adaptation measures.[153]

Finally, taking direct inspiration from *Urgenda*, Plan B Earth, a not-for-profit advocacy organisation seeking to realise the objectives of the Paris Agreement, filed a lawsuit against the UK Secretary of State for Business, Energy and Industrial Strategy alleging

[151] *Gloucester Resources*, n150, at [422]; In New South Wales, 'Scope 3 emissions' are those designated as indirect GHG emissions that occur in the value chain of a private enterprise and include both upstream and downstream emissions. In *Gloucester Resources,* the court held that both direct and indirect GHG emissions should be considered in assessing the impact of the Rocky Hill coalmine on climate change. See *Gloucester Resources*, n150, paras [486]-[513].
[152] *Earthlife Africa Johannesburg v The Minister for Environmental Affairs* (*Thabametsi Case*) (2017) Case number: 65662/16, para [55].
[153] Ibid.

that the latter violated the Climate Change Act (2008) and other UK laws by failing to revise the UK's climate mitigation targets in line with the Paris Agreement and the most up-to-date climate science.[154]Although this case differs from *Gloucester* and *Thabametsi*, in that it does not challenge a particular fossil fuel development project but rather the UK government's climate change policy as a whole, it is nonetheless an administrative lawsuit that challenges governmental failure to consider climate change risks and impacts in accordance with the best available climate science. Plan B Earth specifically argued that by maintaining its current mitigation targets and failing to take into account and properly weigh considerations including *climate change risks* in accordance with current climate science which would compel the adoption of a more ambitious mitigation target, the UK government violated its obligations under the Paris Agreement[155]

Notably, claimants in all three cases heavily relied on either AR5, the IPCC Special Report (SR15) (2018) on the impacts of global warming of 1.5°C above pre-industrial levels or a combination thereof. For example, Gloucester Groundswell drew on AR5 and SR15 to contend specifically that emissions from the coalmine, through the exploitation and combustion of coal, would be fundamentally inconsistent with the existing global 'carbon budget' approach encouraged by the IPCC and policy goals to keep temperature increases to below 1.5°C-2°C above pre-industrial levels as envisaged by the Paris Agreement.[156] It would also further contribute to the cumulative growth of global GHG emissions.[157] Similarly, Plan B Earth's claims also prompted the UK High

[154] *Plan B Earth and Others v Secretary of State for Business, Energy and Industrial Strategy* [2018] EWHC 1892.
[155] Ibid, paras [36], [44], [46], [48], [50].
[156] *Gloucester Resources*, n150, at [422]; IPCC SR15, n118.
[157] *Gloucester Resources*, Ibid.

Court to closely engage with key findings from AR5 and SR15 with respect to global mean temperature changes and associated pathways towards net zero emissions.[158]

In addition to structural similarities in claimants' argumentation, judicial approaches in all three cases are also largely convergent, with presiding courts accepting the centrality and veracity of IPCC reports. As discussed in Chapter Five, it is apparent from Justice Brian Preston's reasoning in *Gloucester Resources* that IPCC and national scientific reports carried considerable weight in relation to the court's assessment of climate change impacts of the proposed coalmine. Justice Preston upheld the Minister's refusal of consent for the Rocky Hill project partly on the basis that the proposed coalmine would produce more GHG emissions that would contribute to dangerous climate change.[159] He concluded that "an open cut coalmine in this part of the Gloucester Valley would be at the wrong place at the wrong time" because it would increase GHG emissions at a time when "a rapid and deep decrease in GHG emissions" is urgently required around the world in order to meet generally agreed climate targets.[160]

In a similar finding, the North Gauteng High Court in Pretoria held that the Minister had erred in approving the coal-fired power plant project before properly weighing climate change considerations when the Environmental Impact Reports clearly revealed that GHG emissions from the project would be significant.[161] The court therefore held that the Minister's decision-making process was deficient since their authorisation was given without reasonable and holistic consideration of the project's adverse climate impacts. In this regard, the court emphasised the importance of anchoring such a process in

158 *Gloucester Resources*, n150, at [22]-[24].
159 Ibid, at [8].
160 Ibid, at [697], [699].
161 *Thabametsi Case*, n152, at [101].

climate science and deemed formal expert reports to be "the best evidentiary means of establishing that [climate change] in its multifaceted dimensions was indeed considered."[162]

Gloucester Resources also evidences direct judicial cross-fertilisation, with Justice Preston observing that "many courts have recognised that climate change is caused by cumulative emissions from a myriad of individual sources."[163] He specifically relied on the findings of the US Supreme Court in *Massachusetts* and The Hague District Court in *Urgenda* that the US transportation sector's and Dutch state's GHG emissions make a meaningful rather than negligible contribution to climate change, respectively.[164] He accordingly concluded that emissions from the Rocky Hill coalmine would also causally contribute to climate change in a manner directly contrary to the Paris Agreement's overall goal of achieving net zero emissions by 2050.[165]

In sum, the consideration of climate change impacts and relevant climate science has arguably become a legal duty of administrative decision-makers and a mandatory requirement of environmental decision-making (including EIAs) in relation to development projects and the adoption of stronger mitigation targets in common law countries. EIAs have been extended to include an assessment of the impacts of proposed development or activity on the climate in many instances.[166] This has led legal scholars like Mayer to assert that climate assessment is an emerging norm of customary

[162] *Thabametsi Case*, n152, at [88].
[163] *Gloucester Resources*, n150, at [516].
[164] Ibid, at [519]-[522].
[165] Ibid, at [525].
[166] Benoit Mayer, 'Climate Assessment as an Emerging Obligation Under Customary International Law' (2019) 68 *International & Comparative Law Quarterly* 2, 273.

international law.[167] Mayer observes that the inclusion of GHG emissions for consideration as part of national EIA processes has become "sufficiently widespread, representative and consistent to constitute a prevailing and, arguably, a 'general' practice."[168]

Indeed, the above cases, which Mayer also identifies as evidence of a growing state practice on climate assessment[169], exemplify how NGO and civil society litigants are engaging in transnational standard-setting by articulating a shared vision of what lawful and competent administrative decision-making and governance on climate change ought to look like. They are specifically lobbying for the adoption of an evidence-based approach to climate change policy-making and periodic revision of national climate mitigation targets in line with the Paris Agreement and 'the current international scientific consensus.'[170] Taken together, these incremental domestic litigation efforts have contributed to the elevation of science-driven climate change impact or risk assessments as transnational best practice and a central pillar of an emergent transnational jurisprudence on climate change.

IV. Direct Cross-fertilisation: The 'Future Generation Lawsuit'

A burgeoning climate youth movement

Among the most morally-charged debates on climate change are those that relate to intergenerational equity. The principle of intergenerational equity (also referred to as an ESD principle) is a central pillar of both the international human rights and

[167] B.Mayer, n166, 274.
[168] Ibid, 282.
[169] Ibid, 283.
[170] *Plan B Earth*, n154, at [3].

environmental law regimes and posits that every generation holds the Earth in common with members of present, past and future generations and has a duty to protect and conserve the Earth's environment and natural resources (including air, water and land) for the benefit of future generations.[171] Despite being a group with heightened vulnerability to climate change, future generations (and their rights and interests) remain largely under-represented within the international climate change and human rights regimes.[172] The Paris Agreement contains only a preambular reference, instructing states to consider the rights of future generations when formulating climate policies.[173] Thus, a major challenge with respect to the protection of future generations under a changing climate is how best to balance their rights against those of current generations.[174]

These familiar debates are very much at the heart of a recent wave of climate change lawsuits initiated by youth plaintiffs around the world. It is becoming increasingly apparent that civil society advocacy and litigation have become fixtures in climate change governance. Climate scientists and NGOs are seeking to give expression to the climate-related grievances of future generations by representing them in lawsuits against their own governments. Indeed, some of the strongest emergent civil society alliances on climate change are those that have been forged between climate scientists and

171 The concept of intergenerational equity has deep roots in many legal traditions around the world. The principle was recognised by the international community in the aftermath of WWII and is enshrined in the UN Charter as well as several UN declarations, resolutions and treaties. Concern for welfare of future generations became a multilateral preoccupation in the lead up to the 1972 Stockholm Conference on the Human Environment. The 1972 Stockholm Declaration recognised the responsibility of states to protect and improve the environment for present and future generations. The 1992 Rio Declaration reiterates this principle. See Edith Brown Weiss, 'Intergenerational equity: a legal framework for global change' in Edith Brown Weiss (ed), *Environmental change and international law: New challenges and dimensions* (United Nations University Press 1992) 3-4.

172 Bridget Lewis, 'The Rights of Future Generations within the Post-Paris Climate Change Regime' (2019) 7 *Transnational Environmental Law* 1, 70.

173 B.Lewis, Ibid, 72; *Paris Agreement* (adopted 12 December 2015, entered into force 4 November 2016) 78 UNTS 54113 <https://unfccc.int/sites/default/files/english_paris_agreement.pdf> accessed 3 February 2017.

174 B.Lewis, Ibid, 71-72.

younger victims of climate change. Logistical support from transnational NGO networks also resulted in youth climate protests being held in over a hundred countries on 15 March 2019,[175] 24 May 2019 and 20 September 2019.

Greta Thunberg, a 16-year-old Swedish youth activist, has become the accidental leader and poster child of this incipient transnational youth movement on climate change.[176] Thunberg appeared before UN delegates at COP-24 and the European Parliament to make the case for a 'climate emergency' and urge governments to pursue science-based action and policies as a matter of moral urgency.[177] At COP-24, Thunberg also led a protest by a group of school students who held up signs stating "only 12 years left" and thereby directly invoking the text of the IPCC's 2018 Special Report, [178] which was again emblematic of the strategic synthesis of the language of climate science, justice and equity by civil society actors as discussed in part III. The recently founded American youth ENGO, the Sunrise Movement,[179] is also employing a merged vocabulary of climate science and climate justice to lobby the US government to adopt the Green New Deal recently tabled by Congresswoman Alexandria Ocasio Cortez – a proposal for sweeping structural-regulatory and socio-economic reform in the United States designed

[175] Damian Carrington, 'Youth climate strikers: "We are going to change the fate of humanity,"' *The Guardian* (1 March 2019) < https://www.theguardian.com/environment/2019/mar/01/youth-climate-strikers-we-are-going-to-change-the-fate-of-humanity> accessed 6 March 2019; Adrian Horton, Dream McClinton & Lauren Aratani, 'Adults failed to take climate action. Meet the young activists stepping up,' *The Guardian* (4 March 2019) <https://www.theguardian.com/environment/2019/mar/04/can-they-save-us-meet-the-climate-kids-fighting-to-fix-the-planet> accessed 6 March 2019.
[176] Kate Aronoff, 'How Greta Thurnberg's Lone Strike Against Climate Became a Global Movement,' *Rolling Stone* (5 March 2019) <https://www.rollingstone.com/politics/politics-features/greta-thunberg-fridays-for-future-climate-change-800675/> accessed 6 March 2019.
[177] Jennifer Rankin, 'Forget Brexit and focus on climate change, Greta Thunberg tells EU' *The Guardian* (16 April 2018) < https://www.theguardian.com/environment/2019/apr/16/greta-thunberg-urges-eu-leaders-wake-up-climate-change-school-strike-movement> accessed 16 April 2019.
[178] John Sutter & Lawrence Davidson, 'Teen tells climate negotiators they aren't mature enough' *CNN* (16 December 2018) < https://www.cnn.com/2018/12/16/world/greta-thunberg-cop24/index.html> accessed 17 April 2019.
[179] Sunrise Movement (2019) <https://www.sunrisemovement.org/> accessed 6 March 2019.

to address climate change over the next decade.[180] The empowerment of youth and the conscious promotion of the welfare of future generations under a changed climate is a more recent, albeit effective strategy being used by transnational NGO networks. It is argued here that these alliances and collaborations between civil society, youth movements and climate scientists across borders have arguably birthed an entirely new and distinctive genre of climate litigation which I term the *future generation lawsuit*.

For the most part, these lawsuits involve new and innovatively framed intergenerational equity and human rights claims that rely on the public trust doctrine and constitutionally enshrined fundamental rights, respectively. The landmark *Juliana et al v USA*, previously discussed in Chapter Four, constitutes the first prototypical example of a future generation lawsuit on climate change. The case has had a profound knock-on effect in terms of inspiring similar lawsuits both within the United States and around the world. The science-backed and equity-rights-driven argumentation employed by the twenty-one youth plaintiffs has been emulated in many subsequent future generation lawsuits.

The amplifying effect of *Juliana et al v USA*

Juliana et al v USA has engendered a spike in future generation cases both within and outside the United States. To briefly recapitulate, the case consists of a federal class action climate change lawsuit filed in 2015 at the District Court of Oregon on behalf of young US citizens by the environmental NGO Our Children's Trust, which "advocates on behalf of youth and future generations [and] for legally binding, science-based

[180] Sunrise Movement, 'Our Road to Victory on a Green New Deal' (2018) <https://www.sunrisemovement.org/gnd-strategy> accessed 17 April 2019.

climate recovery policies."[181] It is notable for being the first case to bring a major constitutional claim in the US with respect to climate change. The twenty-one youth plaintiffs allege that the US government has violated the common law public trust doctrine and their constitutional rights to life, liberty and property by doing little about climate change and exacerbating the problem by continuing to subsidise fossil fuel exploitation and combustion.[182]

The plaintiffs' science-backed claims and argumentation contain three prongs. Firstly, they allege that by supporting and subsidising the extraction, combustion and consumption of fossil fuels and allowing CO_2 to exceed 350ppm, the defendants (the US government and other federal agencies) have dangerously interfered with a stable climate system for the United States and the plaintiffs and violated their fundamental constitutional rights to life, property, dignity of the person and due process.[183] Concurrently framed as personalised endangerment narratives, the plaintiffs' rights-based claims reflect several unifying themes. Relying on IPCC assessments and national and localised scientific studies from NASA and NOAA,[184] the plaintiffs' lawyer and Our Children's Trust's Executive Director and Chief Legal Counsel Julia Olsen identified a host of specific climate change impacts commonly experienced by the plaintiffs. Impacts arising from a warming trend or temperature increases in recent years include a 2015 heatwave in Oregon; warmer summers and an increase in wildfires to which Oregon is particularly susceptible as a heavily forested state; increased allergies and worsening respiratory problems like asthma which many of the plaintiffs suffer

[181] Our Children's Trust, 'Mission Statement' (2017) < https://www.ourchildrenstrust.org/mission-statement/> accessed 23 October 2017.
[182] *Kelsey Cascadia Rose Juliana et al. v. United States of America et al* (Our Children's Trust Case) (2016) Case No. 6:15-cv-01517-TC (Complaint) 4, 7.
[183] Ibid, at [279]-[289].
[184] Ibid, at [68]-[77].

from; snow melt, reduced snowfall and loss of income and livelihood for some plaintiffs and their families employed during ski seasons which have become shorter; loss of income for plaintiffs from farming families due to drought; ocean acidification and warmer temperatures negatively affecting food sources of all plaintiffs (e.g. salmon stocks and fisheries); altered seasons and precipitation patterns adversely affecting and depleting plaintiffs' water sources; loss of habitable lands and housing from sea level rise; and, across the board, a deterioration in the plaintiffs' quality of life, with climate change impacts affecting their enjoyment of nature and outdoor activities in general.[185] Moreover, in the case of several indigenous youth plaintiffs, climate change is interfering with their deep cultural and spiritual connections to their lands.[186] Three of the plaintiffs are also from New York and Louisiana and experienced hardship, trauma and losses as a result of climate change-induced hurricanes in those states in recent years.[187]

Secondly, the plaintiffs alleged violations of their rights under the public trust doctrine (as beneficiaries as well as present and future generations) which is secured by the ninth amendment of the US constitution and several state constitutions.[188] They submitted that the US government is a public trustee of domestic natural resources including "the air (atmosphere), sea, sea shores, water and wildlife."[189] As custodians and public trustees of natural resources, the plaintiffs argued that the defendants owe a duty of care towards them and future generations and have abrogated that duty in failing to protect their rights

185 *Juliana et al v USA*, n182, at [16]-[97].
186 Ibid, at [21]-[23].
187 Ibid, at [63], [72], [86].
188 Ibid, 93-94, at [276]; Anne Richardson Oakes, 'Judicial Resources and the Public Trust Doctrine: A Powerful Tool of Environmental Protection?' (2018) 7 *Transnational Environmental Law* 3, 8; Zachary L. Berliner, 'What About Uncle Sam? Carving a New Place for the Public Trust Doctrine in Federal Climate Litigation' (2018) 21 *University of Pennsylvania Journal of Law and Social Change* 4, 352.
189 *Juliana et al v USA*, n182, at [82].

to life, liberty and property.[190] The latter's conduct and omissions (i.e. subsidisation and approval of fossil fuel projects such as pipelines and aggregate acts such as the extraction, production, transportation, combustion and consumption of fossil fuels) amount to dangerous conduct which infringes on the plaintiffs' fundamental rights.[191] While the public trust doctrine has previously been invoked in other environmental litigation contexts, *Juliana* represents the first major US lawsuit to extend and apply the doctrine to climate change. It has given the doctrine a new lease on life by "[recasting] it in the form of an inherent limitation on sovereign power" and a fiduciary obligation which applies to federal and state governments alike and is potentially subject to judicial enforcement in contexts where government action remains deficient on climate change.[192]

Thirdly, the *Juliana* youth plaintiffs have also claimed that the US government's current climate change policies are deficient because they are not based on the best available science.[193] They accordingly urge that climate change policies going forward will, at a minimum, need to be anchored in state-of-the-art climate science.[194] Attesting to the strong nexus and linkages between contemporary climate science and litigation, *Juliana* also constitutes a pertinent example of a climate change lawsuit that has directly influenced the production of new climate science studies specifically tailored for climate litigation. The claimants have relied on a scientific study specifically produced for this litigation by James Hansen and his team titled '*Young People's Burden,*'[195] discussed in

190 *Juliana et al v USA*, n182, at [286].
191 Ibid, [288]-[289].
192 A.Richardson Oakes, n188, 6.
193 *Juliana et al,* n182, 81-82, at [261]-[262].
194 Ibid.
195 James Hansen et al, 'Young people's burden: requirement of negative CO2 emissions' (2017) 8 *Earth System Dynamics* 1.

Chapter Three. The connection between this study and *Juliana* is further evidenced by the following remarks of Sophie Kivlehan, Hansen's granddaughter and one of the youth plaintiffs in the case:

> I'm excited for Young People's Burden to provide support for Juliana v United States. This paper secures a strong and legitimate foundation for which young people can fight for our right to life, and a viable future. We need the adults to wake up and listen.[196]

This type of close coordination between climate science and law represents another instance of hybrid management and science-law co-production. Hansen's dual role in the case as both an expert witness and a plaintiff blurs the boundaries between his occupation as a climatologist and his role as a climate activist. Moreover, as a repeat player in climate litigation, Hansen has arguably transitioned to the role of the scientist-advocate (discussed in Chapter Three) which typifies the hybridity that permeates much of the knowledge work surrounding climate change (including that of the IPCC) and remains subject to ongoing public misunderstandings about the trans-scientific nature of climate science.

Juliana has engendered a new wave of public trust litigation that is arguably distinctive because it is predominantly driven and articulated by youth plaintiffs and their NGO advocates and firmly anchored in a robust scientific foundation. In these crucial aspects, it represents a clear departure from previous generations of US climate tort litigation in the vein of *Kivalina* and *Comer*. *Juliana's* outsized impact and resonance in the sphere of transnational climate litigation is evidenced by its precipitation of a litany of similar

[196] As quoted in James Hansen, 'Young People's Burden: Requirement of Negative CO2 Emissions' (18 July 2017) < http://csas.ei.columbia.edu/2017/07/18/young-peoples-burden-requirement-of-negative-co2-emissions/> accessed 22 March 2019.

lawsuits in the US. Five future generation lawsuits were filed following *Juliana* in a relatively short time frame between 2017 and 2018 and include *Sinnok v Alaska*, a *North Carolina Petition, Clean Air Council v USA, Reynolds v Florida and Aji P. v State of Washington*.[197] What is strikingly similar in all these cases is that they have been brought forward mainly by youth plaintiffs' or petitioners' who have adopted identical or analogous argumentation to the *Juliana* plaintiffs with respect to violations of their constitutional rights and the public trust doctrine. For example, in *Aji P, Sinnok* and *Reynolds* the youth plaintiffs have claimed that their state governments in Washington, Alaska and Florida, respectively, contributed to climate change by supporting a fossil fuel-based energy and transportation system which has resulted in harm to the states' natural resources and the plaintiffs.[198] They argue that as public trustees of the natural resources in their territory, their state governments have a fiduciary duty to protect public trust resources. They have accordingly sought injunctive relief to compel their governments to abolish existing environmental legislation inadequate for dealing with GHG emissions and instead adopt more ambitious climate-friendly policies and programs, including the preparation of state GHG emission inventories.[199] *Aji P* also involves a repeat player, with one of the youth plaintiffs concurrently appearing as a plaintiff in *Juliana*.

In a further indication of cross-pollination and the transnational stakes and dimensions of this *Juliana* line of cases, ENGOs like Greenpeace, the Sierra Club, Friends of the Earth and the Sunrise Movement have all appeared as *amicus curiae* and provided

[197] Sabin Center for Climate Change Law, 'U.S. Climate Change Litigation: Public Trust Claims' (2019) <http://climatecasechart.com/case-category/public-trust-claims/> accessed 22 March 2019.
[198] *Aji P v State of Washington* (2018) 18-2-04448-1 SEA Wash. Sup. Ct.; *Sinnok et al v State of Alaska* (2017) Case No. 3AN-17-; *Reynolds et al* v *State of Florida* 37 2018 CA 000819 Fla.Cir.Ct.
[199] *Aji P*, Ibid.

supporting statements for the youth plaintiffs in several cases. These NGO amicus briefs map the genesis and development of the public trust doctrine in US environmental law and jurisprudence and make a strong case for its extension and application to climate change in the interest of protecting future generations.[200] These amicus briefs are also trans-scientific in nature as they draw extensively upon climate science data in order to detail specific climate impacts that have or are likely to materialise in each state. For example, the amicus brief in *Aji P* documents Washington state's high susceptibility to ocean acidification, its devastating impact on fisheries and the enormous threat climate change poses to the state's estuarine topography, salmon runs and indigenous modes of subsistence.[201]

At the time of writing, this upward trend of future generation public trust climate litigation shows no sign of waning. This strand of climate litigation is also emergent in the Global South, with a cluster of lawsuits filed in recent years. Inspired by *Juliana*, youth plaintiffs in India, Pakistan and Colombia have alleged violations by their respective governments of the public trust doctrine, their constitutional right to life and their governments' mitigation obligations under the 2015 Paris Agreement.[202] Critically, the NGO claimant behind *Juliana*, Our Children's Trust, has provided direct strategic assistance to the plaintiffs in all of these cases,[203] which attests to the growing

[200] *Juliana et al v USA* (2019) No.18-36082 9th Cir. Ct. (Sunrise Movement Amicus Curiae Brief), n, 2-3.
[201] *Aji P* (Sierra Club et al Amicus Curiae Brief), n198, 10-14.
[202] *Pandey v Union of India*, Sabin Center for Climate Change Law: Columbia Law School, 'Climate Case Chart' (2018) < http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2017/20170325_Original-Application-No.-___-of-2017_petition-1.pdf> accessed 23 April 2019*; Rabab Ali v Federation of Pakistan,* Our Children's Trust, 'Global Legal Actions: Pakistan' (2019) < https://www.ourchildrenstrust.org/pakistan> accessed 8 July 2018; *Future Generation v Ministry of the Environment & Others*, Sabin Center for Climate Change Law: Columbia Law School, 'Climate Case Chart' (2018) <http://climatecasechart.com/non-us-case/future-generation-v-ministry-environment-others/> accessed 23 April 2019.
[203] Our Children's Trust, 'Global Legal Actions' (2018) < https://www.ourchildrenstrust.org/india> accessed 8 July 2019.

transnationalism and active collaboration within civil society that permeates post-Paris climate litigation. These cases are also built on an evidentiary foundation that combines national scientific assessments and more localised climate impact studies. The 9-year-old applicant in the Indian case *Pandey v Union of India* has relied on similar argumentation to the plaintiffs in *Juliana* with respect to claims invoking the public trust doctrine and the principle of intergenerational equity. Furthermore, in reliance upon *Leghari v Pakistan,* the applicant has also requested the National Green Tribunal to direct the Indian government to "take *science-based action* to reduce and minimize the adverse impacts of climate change in the country."[204] The applicant's case is heavily modelled on *Juliana* upon which she relies to argue in identical terms that under the Indian constitution, the public trust doctrine imposes a fiduciary duty on the Indian government to protect the environment and natural resources in its territory from the adverse effects of climate change.[205] The plaintiff also emphatically relies on the parts of Judge Ann Aiken's judgment in *Juliana* which note that the US government's public trust obligations constitute an inherent aspect of sovereignty and embody aspects of intergenerational equity which require it to protect the rights of future generations to a balanced and healthy environment.[206]

In a nearly identical lawsuit in Pakistan, *Rabab* v *Federation of Pakistan*, a 7-year-old girl Rabab Ali filed a constitutional petition in 2016 against the Pakistani government and regional government of Sindh alleging that their continued exploitation and combustion of coal is resulting in violations of the public trust doctrine and the rights of younger generations to life, liberty, property, human dignity, information and equal

[204] *Pandey*, n202, 2.
[205] Ibid, 45.
[206] Ibid, 46.

protection of the law.[207] The plaintiff has further alleged that Pakistan's coal exploitation and combustion, as well as new coal development projects, violate the latter's obligations under the Paris Agreement, particularly its INDC "to promote and support low-Carbon, Climate resilient development."[208] As with *Juliana*, the youth plaintiff has also relied on Hansen's study *Young People's Burden* which forms a core evidentiary component of this case.[209] In the Colombian case *Future Generation v Ministry of the Environment & Others*, the twenty-five youth plaintiffs, supported by the NGO Dejusticia, specifically alleged in their *tutela* (i.e. legal petition) that deforestation in the Amazon and rising temperatures from climate change threatened their rights to a healthy environment, life, health, food and water.[210]

In all these cases, the plaintiffs have stressed that future generations stand to suffer the most from climate change impacts and regulatory inaction by their governments. *Future Generation* also exemplifies the high level of transnational cross-fertilisation that characterises these lawsuits as James Hansen reprised his role as an amicus curiae in this case. In his amicus brief for *Future Generation*, Hansen reiterated the key findings of his study *Young Peoples' Burden*, which was also used in *Juliana*, to assert that the protection of the plaintiffs as future generations is contingent on the Colombian government pursuing climate action in line with its INDCs under the Paris Agreement and geared towards the goal of negative emissions via improved agricultural and forestry practices including reforestation programs.[211]

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[207] *Rabab Ali*, n202, 1.
[208] Ibid, 25, at [32].
[209] Ibid, 15. Hansen's study has been included with the petition in Annexure B.
[210] *Future Generation*, n202; Dejusticia, 'In historic ruling, Colombian court protects youth suing national government for failing to curb deforestation' (2018) < https://www.dejusticia.org/en/en-fallo-historico-corte-suprema-concede-tutela-de-cambio-climatico-y-generaciones-futuras/> accessed 15 August 2018.
[211] *Future Generation* (James Hansen Amicus Curiae Brief), Ibid, 3-4.

V. Conclusion

Recent iterations of climate litigation, particularly in the post-Paris era, reflect new forms of remedial collectivism around climate change. This chapter has shown that a relatively new constellation of civil society actors or litigants – climate scientists, NGOs and climate change victims including future generations – and their epistemic interactions and exchanges represent the foundational core of this new wave of climate litigation. Indeed, it has been argued that NGO-driven climate litigation exhibits many signs of becoming a transformative tool for regulatory change with respect to our current climate crisis. Foremost among them is the strategic fusion of technoscientific and rights and justice-based framings of climate change by transnational civil society networks. Their hybrid-epistemic interactions not only result in the production and mobilisation of 'scientific facts' about climate change, as embodied by IPCC assessments and event attribution studies, but entail a double move. Transnational climate litigation is also serving to validate these trans-scientific accounts of climate change by reference to broader societal values including the protection of fundamental rights and the realisation of intergenerational equity and climate justice.

These dynamics are visible across many jurisdictions and are simultaneously transforming both climate science, as attested by increased demands to generate event attribution science specifically for litigation, and law, as evidenced by the reconfiguration and 'greening' of domestic administrative and environmental law regimes to become better attuned to climate risk. They also appear to vindicate Solnit's claim that "our largest problems won't be solved by heroes. They'll be solved, if they

are, by movements, coalitions, civil society. The climate movement has been first of all a mass effort…"[212] Climate change endangerment narratives, novel arguments on collective and proportional responsibility based on the market share theory, the standardised climate change impact assessment and the future generation lawsuit (predicated on constitutionalised fundamental rights and the public trust doctrine) are all hard-won fruits and knowledge hybrids that derive from this new epistemic synthesis and constitute the seminal building blocks of an emergent transnational common law of climate change.

[212] R.Solnit, n1.

CHAPTER SEVEN

Conclusion

We do not inherit the Earth from our ancestors; we borrow it from our children.

Native American Proverb

As governments around the world continue to exhibit inertia on climate change and under-deliver on the goals of the Paris Agreement, civil society has stepped up its fight against regulatory stasis by turning to the courts. Against the backdrop of our escalating climate crisis and the fight to avert disastrous global warming of 2°C above pre-industrial levels, the IPCC and the global judiciary are increasingly looked upon as more promising sites of regulatory change with the potential to deliver some remedial relief and climate justice. Law and science have furnished civil society actors with powerful vocabularies and tools for addressing climate change and driving regulatory change on the issue. In my PhD project, I have focused on the relationship between climate science and climate litigation and sought to provide one of the first comprehensive analytical accounts of how these spheres of climate change governance are intersecting, shaping one another and co-evolving.

My principal aim has been to develop a detailed STS-inflected account of how the climate science community (IPCC), domestic courts and climate litigants are interacting with one another, how climate science is being used in climate litigation and adjudication and how the transdisciplinary interactions between these actors are reshaping transnational climate change governance. To that end, I have sought to demonstrate that the production and synthesis of climate science by the IPCC, its

certification and transformation by domestic courts, and its recurrent mobilisation by climate litigants around the world is contributing to a new and emergent transnational body of climate change case law, which is epistemologically hybrid and transdisciplinary in character. The key thematic nodes of my PhD thesis are as follows.

I. The Co-constructive Relationship Between Climate Science and Climate Law

My PhD project constitutes a response to the dearth of rigorous legal scholarship on the relationship between climate science and climate law[1] and what I find to be the frequent mischaracterisation of climate science and its role in climate change governance by Science and Technology Studies (STS) accounts on the topic. It accordingly contributes to both STS scholarship and the literature on climate litigation by offering a comprehensive STS-constructivist analysis of climate change knowledge production by the IPCC and the application and mobilisation of climate science in climate litigation and adjudication. My PhD project brings together the literature on climate litigation and the STS-constructivist literature on knowledge production in regulatory scientific institutions in a novel manner. In this regard, it also makes a theoretical contribution by illustrating both the strengths of STS-constructivist frameworks for analysing complex scientific and legal processes and their weaknesses in terms of their critical tendency and potential for deconstructionism.

[1] Joana Setzer & Lisa C. Vanhala, 'Climate change litigation: A review of research on courts and litigants in climate governance' (2019) 10 *Wiley Interdisciplinary Reviews: Climate Change* 3, 11. One notable exception is the paper by Sophie Marjanac & Lindene Patton, 'Extreme weather event attribution science and climate change litigation: an essential step in the causal chain?' (2018) 36 *Journal of Energy & Natural Resources Law* 3.

Relying on the work of pioneers in the field such as Bruno Latour and Sheila Jasanoff, and the latter's critical texts examining the relationship between science and law, I have suggested that STS and constructivist sociological scholarship offer valuable analytical frameworks for understanding the interrelationship between science, policy, and law in contemporary society. I have drawn upon STS-constructivist analyses of regulatory science and the knowledge practices of boundary organisations (i.e. regulatory scientific institutions like the IPCC).[2] More specifically, my project is predicated on the STS-constructivist idea of science as a socially constructed and dynamic knowledge system.[3] I have argued that the IPCC's knowledge production on climate change has always been a political project rather than a purely scientific one, as indicated by its disclaimer that it is a producer of "policy relevant [knowledge]."[4] I have accordingly shown that climate science, and the IPCC's framing of it, fits within the STS models of science for action[5] and trans-science, which is oriented towards addressing questions that transcend pure science and cannot exclusively be answered by it.[6]

In light of the practical exigencies and complexities of climate change regulation, my PhD project develops an alternative conceptualisation of the interrelationship between science, politics, and law than those advocated by existing STS-constructivist accounts. This can only occur when we pay close attention to the knowledge work of regulatory institutions and the institutional processes through which the knowledge base on climate

[2] Sheila Jasanoff, 'A New Climate for Society' (2010) 27 *Theory, Culture & Society* 233; Oren S. Perez, 'The Hybrid Legal-Scientific Dynamic of Transnational Scientific Organisations' (2015) 26 *The European Journal of International Law* 2.
[3] Sheila Jasanoff, 'Is science socially constructed? – And can it still inform public policy?' (1996) 2 *Science and Engineering* 1, 263.
[4] IPCC, 'Statement on IPCC Principles and Procedures' (2016) < http://www.ipcc.ch/pdf/press/ipcc-statement-principles-procedures-02-2010.pdf > accessed 8 March 2016.
[5] David Kennedy, *A World of Struggle: How Power, Law, and Expertise Shape Global Political Economy* (Princeton University Press 2016) 82.
[6] Alvin M. Weinberg, "Science and Trans-Science" (1972) 10 *Minerva* 2, 209.

change is being produced. As noted by David Kennedy, a major shortcoming of the actor/structure/system framework in social scientific work is the tendency to overlook the knowledge work of experts and "to treat expertise as a marginal part of the story."[7] He further contends that such analytic engagement might fruitfully yield a better understanding of the "way expert knowledge operates to constitute actors and shape structures while serving as a tool for people pursuing projects to allocate and capture gains."[8]

I have taken up this call to study 'science in action' by drilling down into the IPCC's knowledge work. My research uncovers the sophisticated manner in which the IPCC and its Working Groups synthesise most of the world's climate science through complex and iterative review cycles involving a range of experts from different backgrounds. I problematise critical STS and sociological perspectives on the IPCC's natural scientific bias and monopolism and my investigations in this regard have yielded two important discoveries. First, the IPCC's knowledge work is far more heterogeneous, dynamic and inclusive of non-scientific and localised knowledge inputs and perspectives than generally assumed by STS scholars and other critics of the IPCC. This is best exemplified by active ongoing collaborations in the Arctic between Earth Scientists, anthropologists and indigenous peoples. Moreover, the IPCC assessment cycle strikes a healthy and well-functioning balance between instances of both boundary work (i.e. performed by Working Group I) and more hybrid and interdisciplinary knowledge work (i.e. performed by Working Groups II and III).

[7] D.Kennedy, n5, 82.
[8] Ibid.

Second, both popular and scholarly accounts perpetuate fictions and misconceptions about the essential or 'pure' nature of climate science. I have shown that climate science is distinctive both for its mode of production and its evolution as a practical body of knowledge specifically designed for policymaking, regulation and, increasingly, legal process. I have accordingly argued that climate science is best conceived of as applied science and trans-science. I have also demonstrated that the changing and multi-faceted role of the climate scientist as an advocate, activist, expert witness and repeat player in climate litigation, can also be better understood in terms of and is fundamentally consistent with this more nuanced bipartite framing of climate science. In sum, my PhD project offers up this more textured account of climate science which sheds light on the deep formative links and interconnections between the science and law of climate change. This development has largely eluded scholarly attention and analysis to date.

II. IPCC Assessments, Climate Adjudication and the Recasting of Evidentiary Boundaries

My PhD project also contributes to transnational environmental law scholarship by providing new insights into the treatment and role of science in climate adjudication and litigation. It advances our understanding of the impact of a growing and increasingly consolidated body of climate science on adjudicative processes of fact-finding as well as evidence gathering and evaluation. In common law societies, there is a tension between law and science that arises as a consequence of the adversarial character of law coming into contact with scientific norms and consensus, as litigation generally promotes contestation rather than 'truth' seeking. Traditional legal-adjudicative evidentiary and fact-finding procedures do not always align with modes of scientific

inquiry. Within the sciences, there are certain theories that are so firmly entrenched that they have attained the status of scientific law or consensus and a sense of permanence.[9] As an established body of knowledge and high consensus field, climate science fits this mould.

In contrast, evidence gathered in the aftermath of environmental crises are often inchoate forms of science requiring input from multiple researchers to challenge underlying hypotheses and supporting data.[10] Furthermore, evidentiary processes within adversarial models of litigation and adjudication (i.e. civil or criminal procedure) compel the parties to engage in the piecemeal dissection and mobilisation of scientific testimonies to support or contest discrete findings of law and fact.[11] The scientific process by contrast remains committed to a larger project of fine-tuning and improving scientific knowledge that transcends any particular litigation scenario. Moreover, the consolidation of a scientific consensus on the anthropogenic causes of climate change by the IPCC potentially obviates the utility of adversarial modes of evidence gathering and fact-finding in court, at least with respect to general causation enquiries. This is consistent with Fisher et al.'s observation of climate change as legally disruptive because it compels a reconceptualisation of the causation issue, with linear causation requirements being ill-suited to the climate change context due the diffuse and transboundary nature of GHG emissions.[12] These deficiencies within adversarial litigation and adjudication

[9] Keum J. Park, 'Judicial Utilization of Scientific Evidence in Complex Environmental Torts: Redefining Litigation Driven Research' (2011) 7 *Fordham Environmental Law Review* 2, 505.
[10] Ibid.
[11] Ibid.
[12] See Elizabeth Fisher, Eloise Scotford & Emily Barritt, 'The Legally Disruptive Nature of Climate Change' (2017) 80 *Modern Law Review* 2.

systems have also prompted calls for tort law reform within the United States to better accommodate climate change claims.[13]

Through a fine-grained examination of climate change lawsuits around the world, I have shown that the evidentiary dynamics of climate litigation, and the role of science therein, are indeed of a different order. This is specifically due to the distinctive universal character and currency of IPCC assessment reports. I have proposed that the judicial uptake, evaluation and application of IPCC assessments is resulting in courts around the world adjusting or transforming evidentiary standards and legal doctrines to facilitate the adjudication of climate change questions. Occasionally, this has involved the judicial relaxation or expansion of evidentiary boundaries to allow for the inclusion of generalist climate science. This has led some courts to reject arguments about a state's negligible contribution to global climate change and make findings of proportional responsibility as illustrated by the *Urgenda* decisions. This marks a significant departure from how the limited scope of evidencing generally works in civil and criminal legal procedure where individuated and divergent scientific testimonies are relied upon.

In this regard, I have shown that evidentiary enquiries in climate adjudication and litigation are always automatically tethered to a universal body of science due to the inherently multi-scalar (i.e. concurrently global and localised) nature of climate change and its impacts. Climate adjudication, particularly in the post-Paris era, is marked by a high level of science-law hybridity, whereby the IPCC is ascribed a pivotal fact-finding role in most climate change lawsuits around the world. IPCC assessments have become an enabling adjudicative tool, with courts in both the United States and around the world

[13] See Douglas A. Kysar, 'What can climate change do about tort law?' (2001) 41 *Environmental Law* 1.

routinely integrating scientific statements on climate change into their jurisprudence. Through recurrent application, courts have also transformed IPCC assessments into a usable body of shared knowledge for litigation and a mandatory framework to guide more climate-responsive administrative decision-making and policymaking. In sum, courts around the world are explicitly privileging the IPCC's technoscientific account of climate change and have firmly cemented the status of IPCC assessments as a baseline for sound climate change governance. Moreover, the climate crisis and the subsequent judicial elevation of IPCC climate science are also formatively consequential for and transformative of law, as they are contributing to a transnational process of legal (re)ordering.

III. Towards a Shared Body of Transnational Climate Change Case Law: A New Project of Socio-legal (Re)ordering

Finally, My PhD project contributes to the literature on transnational environmental law by offering a new conceptualisation of post-Paris climate change governance extending beyond the standard range of legislative and executive responses and initiatives. It accordingly puts forward an analytical account of the ways in which transdisciplinary interactions between climate science and law are reshaping transnational climate change governance. This represents a new project of normative restructuring and socio-legal (re)ordering in response to climate change. I have proposed and demonstrated that the intersection of climate science and law is constitutive of two interlocking, transformative developments in climate change governance.

Firstly, climate science is changing the law and legal practice on climate change in several important ways that merit close attention. Domestic courts and judges are at the heart of this shift and are increasingly embracing their role as transnational institutions and key actors in climate change governance. Networked judicial interactions outside the courtroom have sometimes resulted in the production of soft law frameworks on climate change. Moreover, through adjudication, judges are relying upon IPCC assessments and other climate science to flexibly and creatively interpret and adapt existing legal principles and doctrines to address climate change questions Scientifically-attuned climate adjudication is also serving to encourage more climate-responsive and evidence-based administrative decision-making.

This process is also being reinforced and consolidated by NGO-driven climate litigation. An energised civil society has seized on the momentum of the Paris Agreement and recent high-profile pro-regulatory climate litigation in *Urgenda v The Netherlands* and *Juliana et al v USA*[14] to launch a series of parallel efforts in jurisdictions around the world that directly emulate these cases. NGO litigants, several of whom are repeat players in these cases, are attempting to replicate the *Urgenda-Juliana* model by strategically running similar or even identical arguments and claims, many of which are anchored in IPCC assessments and event attribution science. These NGO-driven efforts, which involve the replication of legal arguments and the filing of analogous claims grounded in universal climate science, are symptomatic of a high level of consciously

[14] I refer here to *Juliana's* success on narrower terms as the first instance decision of the District Court of Oregon. At the time of writing, the case is still pending a final resolution and a successful outcome overall is by no means a foregone conclusion. See Judge Ann Aiken's judgement in *Kelsey Cascadia Rose Juliana et al. v. United States of America et al* (Our Children's Trust Case) (2016) Case No. 6:15-cv-01517-TC. Also discussed in Chapter Four.

engineered strategic convergence in global legal practice on climate change in the post-Paris era.

Secondly, legal processes like litigation and adjudication are, in turn, informing and influencing the production of some new scientific studies on climate change. This is partially a response to earlier instances of failed tort litigation in the United States where claimants failed to prove causation. I have argued here that climate science is a specialised body of knowledge specifically intended for policy design, regulation and litigation. Certain event attribution studies, like The Carbon Majors study, constitute salient examples of trans-science, as they are being produced specifically to facilitate post-Paris climate litigation and adjudication and enable the resolution of (previously insurmountable) causation enquiries.

In addition to engaging in a diagnostic exercise of identifying an emergent and shared body of transnational case law on climate change, my PhD project has also provided a preliminary articulation of its content. The foundational tenets or core by-products of this science-law synthesis include endangerment narratives which are concurrently undergirded by the vocabularies of IPCC science and human rights, market share approaches to responsibility, the global standardisation of climate change impact assessments through science-attuned adjudication, and the future generation lawsuit typified by youth claimants' revival of and reliance upon the public trust doctrine. I have shown that these transnational strategies, ideas and trends in legal practice on climate change are distinctive and hybridised precisely because they are the product of science-law interactions and exchanges. In sum, climate science and law are locked in a dynamic process of mutual reinforcement and co-construction. My PhD thesis constitutes a first

attempt to map this development which is not yet well recognised or understood in the literature on climate litigation and transnational environmental law. More broadly, what does this development mean for law as a field, discipline or praxis? I have suggested that climate change is inherently transformative and reordering of something about the law's ideas of itself, both as praxis and in the ways in which it sees the world. It is changing the law's internal ideas about what constitutes equity and justice in the face of global ecological collapse.

IV. Limitations & Future Research Prospects

A major focus of my PhD work has been on the role of courts in climate change governance. This discussion has been delimited in terms of my specific examination of the links between climate science and law and, consequently, the relationship of courts to other institutional actors such as the IPCC and ENGOs. However, another interesting line of enquiry not pursued here is how the reconfiguration of judicial power in response to climate change is impacting upon existing political arrangements in constitutional democracies. A possible unintended consequence of science-law interactions with respect to climate change may be the expansion of judicial authority at the expense of legislative and executive authority. In other words, are courts assuming policymaking functions in this area and undermining the separation of powers? My PhD work has not examined the implications of the transnational growth of judicial power for democratic governance – an extensive topic that merits separate treatment. Thus far, such scholarly explorations on climate adjudication and the separation of powers are chiefly expressed

as commentary on the *Urgenda* case.[15] Further critical reflection and research is needed to develop a deeper and more textured understanding of the evolving relationship between the judiciary, other regulatory actors and global administrative regimes and networks on climate change governance.

By largely concentrating on the world of legal practice and adjudication, my PhD project has also not explored in detail the domestic enforcement of climate change norms, which is dependent on specific national contexts and "legally, scientifically and institutionally complex."[16] Existing scholarly contributions in this regard include Scotford et al.'s analysis of national climate change laws across Commonwealth countries, including legal measures designed to "implement climate change policy, including climate change legislation and regulatory instruments such as emissions trading schemes and energy efficiency measures,"[17] for the purpose of identifying the least as well as most effective and well-functioning governance approaches geared towards delivering on the goals of the Paris Agreement. Further context-sensitive research in this vein could help to map the translation, uptake and implementation of emergent judicially-enacted soft law frameworks on climate change in domestic regulatory settings.

My PhD project has also briefly touched upon the issue of climate denialism to highlight the potential pitfalls of STS constructivist methodologies, which have been repeatedly misappropriated by climate deniers to attack the mainstream IPCC account of climate change. The nexus between climate denial and anti-regulatory litigation, particularly

[15] See Josephine van Zeben, 'Establishing a Governmental Duty of Care for Climate Change Mitigation: Will Urgenda Turn the Tide?' (2015) 4 *Transnational Environmental Law* 2.
[16] Elizabeth Fisher & Eloise Scotford, 'Climate Change Adjudication: The Need to Foster Legal Capacity: an editorial comment' (2016) 28 *Journal of Environmental Law* 1, 1.
[17] Eloise Scotford, Stephen Minas & Andrew Macintosh, 'Climate Change and National Laws Across Commonwealth Countries' (2017) 43 *Commonwealth Law Bulletin* 3-4.

against prominent members of the global climate science community, is a related topic that merits separate treatment and investigation. Oreskes and Conway's work, *Merchants of Doubt*, offers a pertinent springboard for further scholarly exploration of counternarratives to climate science and their role in recently intensified efforts by the fossil fuel industry and its allies to thwart progressive climate change regulation by peddling doubt about climate science[18] and pursuing vexatious litigation against climate scientists. The Climate Science Legal Defense Fund (CSLDF), an American advocacy group defending the interests of climate scientists, reported a sharp increase in frivolous lawsuits against climate scientists in 2017, particularly since the election of Donald Trump.[19] Thus, climate litigation is also of scholarly interest as a mechanism that is being (mis)used by well-resourced climate deniers (fossil fuel corporations, politicians, conservative think-tanks, front groups etc.) to undermine climate science and obstruct climate change regulation. As this type of anti-regulatory litigation remains largely concentrated in the United States, it does not directly contribute towards my thesis on the transnationalisation of climate law and legal practice and was therefore excluded.

My PhD project has also run up against certain methodological limitations. Once published, the IPCC's Sixth Assessment Report[20] is likely to provide further and deeper insights into the links and interconnections between climate science and legal processes such as adjudication and litigation, particularly on event attribution science. Furthermore, my PhD project has predominantly engaged in doctrinal-textual analysis

[18] Naomi Oreskes & Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues From Tobacco Smoke to Global Warming* (Bloomsbury 2010).
[19] Climate Science Legal Defense Fund, 'CSLDF in the Guardian: Climate Scientists are Under Attack from Frivolous Lawsuits' (2016) < https://climatesciencedefensefund.org/2016/07/07/csldf-in-the-guardian/> accessed 28 June 2017.
[20] The IPCC's Sixth Assessment Report is expected to be rolled out from April to October 2021 (one per Working Group) and the Synthesis Report in June 2022. See IPCC, 'Sixth Assessment Report' (2019) <https://www.ipcc.ch/assessment-report/ar6/> accessed 13 August 2019.

of primary materials such as case law and legislation and relied on secondary materials like articles, books and media publications as complementary interpretive aids. Alternatively, other equally valid and fruitful ways of seeing and understanding the research questions raised by my PhD work are offered by sociological, socio-legal and anthropological frameworks.

For example, there is considerable merit in conducting ethnographic research on governance activities that are occurring in the shadow of climate litigation and adjudication, particularly with respect to the networking initiatives and capacity building efforts of courts and climate litigants. Institutional ethnographic studies would further enrich our understanding of judicial and ENGO networks and serve to demystify their internal cultures and politics and unpack the range and complexity of their epistemological and governance activities. Of the three actors examined in my PhD work, only the IPCC has been the subject of close study by STS scholars.[21] My PhD project has crafted an STS-style account of domestic courts and ENGOs in the context of climate change governance. This could be usefully complemented and bolstered by further ethnographic study. In this regard, sociological and anthropological perspectives on law, justice, legal practice and courts[22] abound and may serve as instructive templates for carrying out such research.

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[21] See Clark Miller, 'Hybrid Management: Boundary Organizations, Science Policy, and Environmental Governance in the Climate Regime' (2001) 26 *Science, Technology, & Human Values* 4; Shadur Agrawala, 'Structural and process history of the Intergovernmental Panel on Climate Change' (1998) 39 *Climatic Change* 1; Mark Vardy, Michael Oppenheimer, Navroz K. Dubash, Jessica O'Reilly & Dale Jamieson, 'The Intergovernmental Panel on Climate Change: Challenges and Opportunities' (2017) 42 *Annual Review of Environment and Resources* 1.

[22] For example, see Sally Engle Merry, 'New Legal Realism and the Ethnography of Transnational Law' (2006) 31 *Law & Social Enquiry* 4; Susan S. Silbey, *Law and Science, Volume I: Epistemological, Evidentiary, and Relational Engagements* (Routledge 2008); Susan S. Silbey, 'Legal cultures and cultures of legality,' in John R. Hall et al (eds), *Handbook of Cultural Sociology* (Routledge 2010), Annelise Riles, *The Network Inside Out* (University of Michigan Press 2000); Carol J. Greenhouse, 'Judgment and the Justice: An Ethnographic Reading of the Sotomayor Confirmation Hearings' (2010) 8 *Law, Culture & The Humanities* 3.

V. Final Reflections

Few of us remain untouched by climate change. At the time of writing, we have emerged from unprecedented European heatwaves and the hottest July on record, which scientists are attributing to climate change.[23] Monsoonal flooding and human displacement have repeatedly devastated my birth country of India while my home country of Australia experienced unprecedented bushfires in January 2020 – problems that are expected to worsen with each passing year. Confronted with such sobering realities, legal professionals and scientists of all stripes are often in the vanguard when dealing with the fallout from climatic events that now routinely claim both human and non-human victims. The sense of urgency with which climate scientists, NGO advocates, lawyers and judges are tackling climate change is hardly surprising and, for many, a welcome reprieve in the face of tepid and disingenuous responses from political elites. In an otherwise bleak global political landscape marked by the dual threats of rising right-wing populism and climate catastrophe, these new kinds of transnational networks and alliances provide some grounds for cautious optimism. The growing activism on display within these networks and communities is here to stay, and the potential for fruitful collaborations and the development of more creative knowledge-based regulatory responses, modes of governance and societal reordering remains within our reach.

[23] Damian Carrington, 'Climate change made European heatwave at least five times likelier,' *The Guardian* (2 July 2019) <https://www.theguardian.com/science/2019/jul/02/climate-change-european-heatwave-likelier> accessed 13 August 2019.

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